JOURNAL OF THE

SMPTE

81 Cathode-Ray-Tube and Photographic-Film Characteristics Related to Film Recording for Television • *Meier Sadowsky*

85 Video-Tape Analyzer • *A. A. Goldberg and M. R. Hannah*

89 Selection and Specification of Rear-Projection Screens • *Petro Vlahos*

96 A New Approach to Location Recording Techniques • *Jack J. Clink*

98 Controlling External Noises for Recording Studios • *Donald P. Loye*

101 The Control of High Power Xenon Flashes by Magnetic Switching • *E. J. G. Beeson*

106 Smear Camera-Techniques • *T. P. Liddiard and B. E. Drimmer*

111 The Core Camera: Continuous Receptivity — One Rotating Element • *J. N. Whyte*

142 Résumés–Resumenes–Zusammenfassungen

89th SMPTE Convention • May 7–12 • King Edward Sheraton, Toronto

volume 70 • number 2 **FEBRUARY 1961**

JOURNAL of the SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS

PUBLICATION OFFICE TWENTIETH AND NORTHAMPTON STREETS EASTON, PA.

Officers

President, 1961–62
JOHN W. SERVIES, National Theatre Supply Co., 92 Gold St., New York 38, N.Y.

Executive Vice-President, 1961–62
REID H. RAY, Reid H. Ray Film Industries, 2269 Ford Parkway, St. Paul 16, Minn.

Past-President, 1961–62
NORWOOD L. SIMMONS, Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38, Calif.

Engineering Vice-President, 1960–61
DEANE R. WHITE, Photo Products Dept., E. I. du Pont de Nemours & Co., Inc., Parlin, N.J.

Editorial Vice-President, 1961
GLENN E. MATTHEWS, Research Labs., Bldg. 59, Kodak Park, Eastman Kodak Co., Rochester 4, N.Y.

Financial Vice-President, 1960–61
ETHAN M. STIFLE, Eastman Kodak Co., 342 Madison Ave., New York 17, N.Y.

Convention Vice-President, 1961–62
HARRY TEITELBAUM, Hollywood Film Co., 956 Seward St., Hollywood 38, Calif.

Sections Vice-President, 1960–61
GARLAND C. MISENER, Capital Film Laboratories, 1905 Fairview Ave., N.E., Washington, D.C.

Secretary, 1961–62
HERBERT E. FARMER, 7826 Dumbarton Ave., Los Angeles 45, Calif.

Treasurer, 1960–61
G. CARLETON HUNT, General Film Laboratories, 1546 N. Argyle Ave., Hollywood 28, Calif.

Governors, 1960–61
MAX BEARD, 10703 East Nolcrest Dr., Silver Spring, Md.
EDWARD H. REICHARD, 13059 Dickens St., North Hollywood, Calif.
MALCOLM G. TOWNSLEY, Bell & Howell Co., 7100 McCormick Rd., Chicago 45, Ill.
W. W. WETZEL, 725 Ridge St., St. Paul, Minn.
CHARLES W. WYCKOFF, 69 Valley Rd., Needham 92, Mass.

Governors, 1961–62
JAMES W. BOSTWICK, General Motors, 465 W. Milwaukee, Detroit 2, Mich.
G. R. CRANE, 212 24th St., Santa Monica, Calif.
ROBERT G. HUFFORD, Eastman Kodak Co., 6706 Santa Monica Blvd., Hollywood 38, Calif.
WALTER L. KISNER, 123 Browncroft Blvd., Rochester 9, N.Y.
KENNETH M. MASON, Eastman Kodak Co., Prudential Bldg., Room 2006, Chicago 1
RODGER J. ROSS, 784 Dutchess Dr., Applewood Acres, Port Credit, Ont., Canada

Governors and Section Chairmen, 1961
JAMES W. KAYLOR, Movielab Film Labs., 619 West 54th St., New York 19
RALPH E. LOVELL, 2554 Prosser Ave., Los Angeles 64, Calif.
WILLIAM H. SMITH, 9930 Greenfield Rd., Detroit 27, Mich.

Section Chairmen
DONALD E. ANDERSON, 1718 Valley View Ave., Belmont, Calif.
ROBERT M. FRASER, ITEK Corp., 700 Commonwealth Ave., Boston 15, Mass.
ERIC C. JOHNSON, 139 Tobey Rd., Pittsford, N.Y.
MALCOLM D. McCARTY, 440 Wildwood Rd., Dallas, Texas
FRANK M. McGEARY, M-P Laboratories, 781 South Main St., Memphis 6, Tenn.
FINDLAY J. QUINN, TransWorld Film Laboratories Ltd., 4824 Cote des Neiges Rd., Montreal, Que., Canada
WESLEY R. SANDELL, Kodak Processing Lab., 4729 Miller Dr., Chamblee, Ga.
WILLIAM E. YOUNGS, 231 Mayflower Dr., McLean, Va.

Editorial Office

55 West 42 St., New York 36, New York

Editor—VICTOR H. ALLEN
Advertising Manager—DENIS A. COURTNEY

BOARD OF EDITORS

Chairman—PIERRE MERTZ
66 Leamington St., Lido, Long Beach, N.Y.

HARLAN L. BAUMBACH	CLYDE R. KEITH
MAX BEARD	W. I. KISNER
GERALD M. BEST	RALPH E. LOVELL
GEORGE R. CRANE	C. DAVID MILLER
HAROLD E. EDGERTON	HERBERT W. PANGBORN
CARLOS H. ELMER	BERNARD D. PLAKUN
CHARLES R. FORDYCE	WALDERMAR J. POCH
LLOYD T. GOLDSMITH	ALLAN L. SOREM
LORIN D. GRIGNON	R. T. VAN NIMAN
A. M. GUNDELFINGER	DEANE R. WHITE
CHARLES W. HANDLEY	W. T. WINTRINGHAM
RUSSELL C. HOLSLAG	CHARLES W. WYCKOFF

EMERSON YORKE

Papers Committee Chairman—ROBERT C. RHEINECK
CBS News, 485 Madison Ave., New York 22, N.Y.

Subscriptions to nonmembers, $12.50 a year (outside continental United States, add $1.00 for postage); subscribers residing in countries which participate in UNESCO may use UNESCO coupons in submitting subscription payments in the event other means of remitting are not available; single copies, $2.00 for one-part issues, $2.50 for special two-part issues. A 10% discount is allowed to individual members and accredited agencies on orders for subscriptions and single copies. A list of priced and gratis publications is available. Order from the Society's Headquarters Office, 55 West 42d St., New York 36.

THE SOCIETY is the growth of over forty years of achievement and leadership. Its members are engineers and technicians skilled in every branch of motion-picture film production and use, in television, and in the many related arts and sciences. Through the Society they are able to contribute effectively to the technical advance of their industry. The Society was founded in 1916 as the Society of Motion Picture Engineers and was renamed in 1950.

Membership in Sustaining, Active, Associate or Student grades is open to any interested person according to his qualifications. Information about membership, technical activities and standards and test films for the industry is available from Society Headquarters. Members residing in countries which participate in UNESCO may use UNESCO coupons in submitting membership payment in the event other means of remitting are not available.

SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS

Headquarters Office: 55 West 42d St., New York 36, N.Y. Cables: Somopict Telephone: LOngacre 5-0172

Executive Secretary: CHARLES S. STODTER

Published monthly by the Society of Motion Picture and Television Engineers. Publication office 20th and Northampton Sts., Easton, Pa. Second-class mail privileges authorized at Easton, Pa. This publication is authorized to be mailed at the special rates of postage prescribed by Section 132.122.

Copyright 1961, by the Society of Motion Picture and Television Engineers, Inc. Permission to republish Journal text material must be obtained in writing from the Society's Headquarters Office, 55 West 42nd St., New York 36. The Society is not responsible for statements of contributors.

Printed by Mack Printing Company, Easton, Pa.

Journal of the Society of Motion Picture and Television Engineers

VOLUME 70 • NUMBER 2 • FEBRUARY 1961

Cathode-Ray-Tube and Photographic-Film Characteristics Related to Film Recording for Television

By MEIER SADOWSKY

Today's needs in TV film recording are related to the cathode-ray-tube parameters of phosphors, screen, aluminizing, spot size, and operating characteristics. The spectral emission and decay characteristics of phosphors pertinent to photography are described; the effects of the physical characteristics of the phosphor and screen are evaluated in relation to problems of uniformity and impurities. Methods of exposure and the response characteristics of commercially available film are evaluated. The relation of phosphor screen characteristics to film in the optical system is shown.

In the television field, film recording is used in order to obtain a photographic film record of a television program. This is done to obtain:

(1) A record of the particular program for reference, for legal purposes, or for duplication.

(2) A record, if needed, for the program's sponsor.

(3) A filmed program for showing on non-network TV stations.[1]

(4) A record for rerun at a later time.[2]

In the last few years there has been an increasing use of tape recording. However, there is still, and probably will be, a continued use of photographic recording because all stations are not sufficiently equipped with tape recorders and transfer mechanisms. The tape, at least at present, has a limited number of reruns in normal station use. Tape machines are comparatively expensive, and the program may need to be shown in the sponsor's office or other such areas where tape machines are not available. Finally, there may be a desire for slow-motion viewing of the recorded program, and this is most easily done with photographic film.

The important parameters and problems in film recording devolve about the transfer characteristics. Essentially, the transfer characteristic is a relationship between the input signal into the system and the output signal of the system.[3] This involves the relationship between the input video voltage and the corresponding light intensity upon the face of the picture tube; the relationship between the light output of the picture tube and the sensitivity and response of the film used; and finally, the reproduction of the film. In order to evaluate some of these parameters, we will consider in detail the cathode-ray tube, the film, and the shutter system.

The Cathode-Ray Tube

Basically, a cathode-ray tube is a device to convert electrical energy into light energy. In this particular application it is important that the light energy be displayed with high resolution, adequately high intensity, proper spectral emission and proper light decay characteristics, as well as overall and detailed uniformity.

It is desirable to have as high a resolution (maximum information per unit area) as is consistent with required brightness levels, tube screen size and angle subtended by the optical system. This resolution is related to the size of the spot of light coming from the tube which, in turn, is a function of the electron beam diameter and the diffusing factors of the screen and the glass. The electron beam diameter is a function of the electron optics, the current density, the voltage used, the gun design and the tube geometry. It is also determined by the screen since the light emitted by the phosphor particles is diffused to some extent by the particulate layer.[4]

As seen in Fig. 2, the cathode-ray-tube screen is a fairly uniform layer of phosphor particles deposited upon the inside of the glass face. The particular phosphor used will determine the light characteristics resulting from electron excitation. In Fig. 3 is a family of spectral emission curves of some of the phosphors which have been used in film recording.*

* Video recording is used in many non-broadcast studio applications, both military and commercial. Some of these require special phosphor characteristics, for example, the P18.

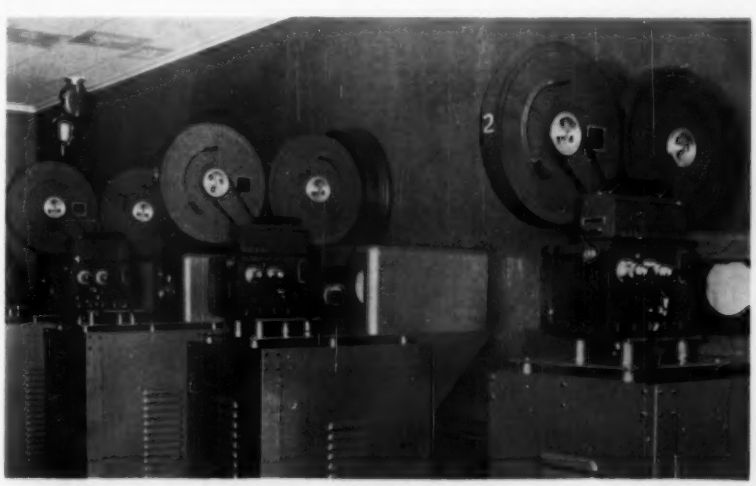


Fig. 1. Bank of 16mm film recorders, Acme Film Laboratories, Hollywood, Calif.

Presented on May 5, 1960, at the Society's Convention at Los Angeles by Meier Sadowsky, Continental Electronics Corp., 2724 Leonis Blvd., Los Angeles 58.
(This paper was first received on May 13, 1960, and in final form on February 1, 1961.)

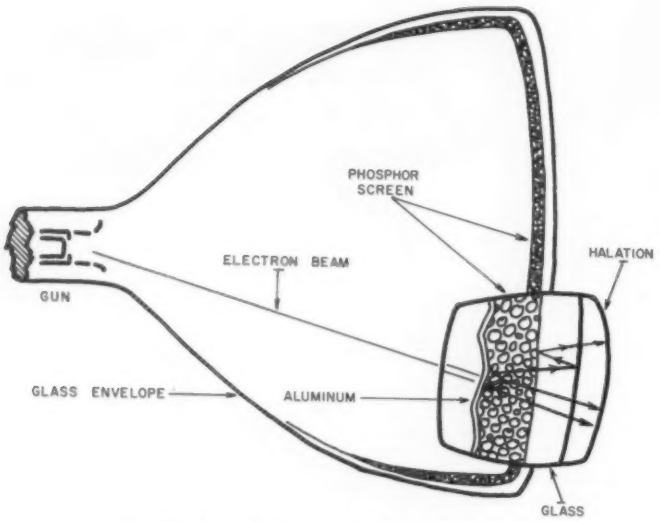


Fig. 2. Schematic diagram of cathode-ray tube.

Since the film used will have a sensitivity in certain spectral regions, obviously a phosphor must be chosen whose spectral emission coincides as closely as possible with the spectral sensitivity region of the film. In Figs. 4, 5 and 6 the decay characteristics of these same phosphors are shown. Obviously if a long decay phosphor is used, a smearing of the images recorded on the film will result. On the other hand, an extremely short decay phosphor may not be needed because there is a certain amount of integration of the light beam on the film. The particular film used, the shutter system employed and the film transport applied will determine the minimum decay characteristics required. It may be added that there are differences of opinion as to how short a phosphor decay screen is necessary to eliminate certain undesirable aspects such as shutter bar.

Phosphors vary in cathodoluminescent efficiencies. In general the sulfides are more efficient than the silicates, but there are draw-backs to each. At high-current densities the silicate-type phosphors are preferable because they do not current-saturate as do the sulfide-type phosphors. At low-current densities, the sulfide-type phosphors are more efficient.[5]

Cathode-Ray-Tube Screen

The screen itself must be as uniform and smooth in texture as possible, since the photographic film will pick up any nonuniformities, or nonhomogeneities. This is no mean trick, considering that the particles are rather course (1 to 10 microns), of varying sizes, and applied most advantageously by a liquid settling method.[6] First of all the screen must be free of: holes (absence of phosphor particles), spots (nonphosphor particles, or particles of a foreign phosphor), ripples (lines or areas caused by a disturbance of the layer during screen application), mottling (slight differences in gray or light emission from place to place on the screen usually due to poor lacquering), water marks (caused by poor drying technique), variation in light out-

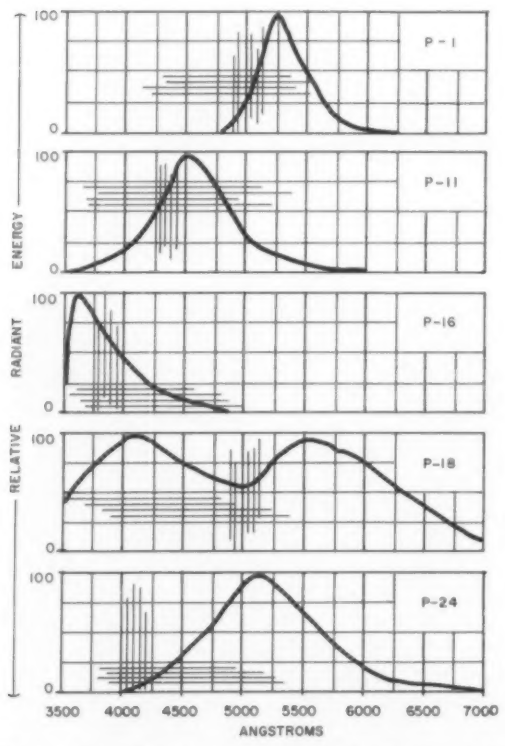


Fig. 3. Spectral emission curves of phosphors used in recording.

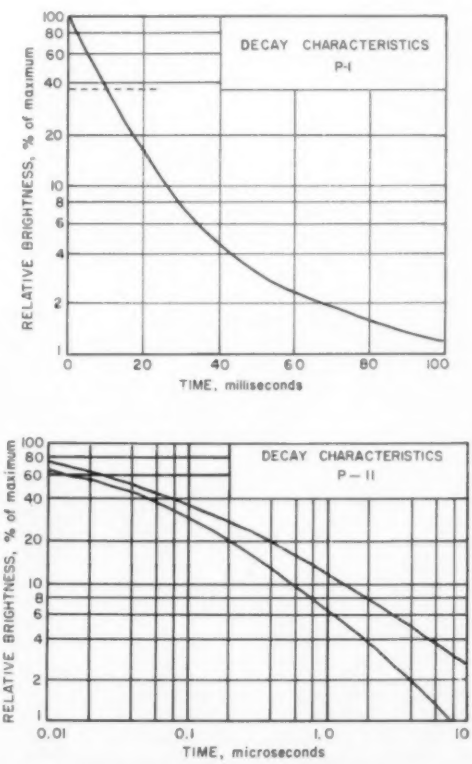


Fig. 4. Decay curves of P1 and P11 phosphors.

put (caused by poor screening technique), variation in color (due to either poor technique of screening, separation of components in a two-component screen, or aggregation of one or both of the components to cause a coarse color mixture), and coarse structure (poorly deposited layer, large particles, or aggregations).

It is also important to have an optimum screen thickness for the particular conditions of tube operation. Another factor which affects the screen condition is that of the aluminum layer backing. The purpose of the aluminum layer is twofold. First, it keeps the screen at second anode potential, thus keeping the essentially insulating screen layer from accumulating a negative charge during high-voltage operation. Secondly, when properly applied, it acts as a reflective layer to enhance the light output of the screen, by reflecting back light to the front which would normally fall back into the tube. However, a reflective aluminum film cannot be applied or evaporated directly onto the matte surface of the screen layer because *it* would have a matte surface. It would also require too thick a layer of aluminum in some areas in order to be electrically conductive. While it is true that aluminum is pervious to electrons, there is some attenuation of the electron beam.[7]

An optimum aluminum thickness for each particular voltage range is required. In order to circumvent this problem, the practice is to apply a smooth lacquer film on the back of the screen so that it stretches "peak to peak" on the phosphor particles.[8,9] This provides a smooth substrate for subsequent aluminum evaporation. After the aluminum is deposited, the lacquer film is baked out leaving the smooth aluminum layer stretched in place "peak to peak." This acts somewhat like the reflector on a head lamp.

The procedure, however, presents some problems. The thin lacquer film must not contaminate the phosphor, and must be applied so that there are no drying lines or water marks, must be thin enough so that on bake-out no carbonization results, must be fairly uniform in thickness and free from the tiniest holes or nonhomogeneities. The aluminum must be deposited in a proper vacuum so that oxidation will not result, must be deposited in the appropriate thickness by control of the evaporating process, and must not sputter on evaporation. The whole system (the cathode-ray-tube interior) must be kept sufficiently clean so that contaminative materials are not deposited beneath or on top of the aluminum surface. This might cause blistering, oxidation, pealing, discoloration, etc.

The ideal screen then, for the highly critical requirements of photographic film recording, is one which has the proper phosphor spectral emission and decay characteristics, adequate cathodoluminescent efficiency, very fine texture, extreme homogeneity, optimum screen and aluminum thickness, uniformity of that thickness, uniformity of color, and as high a contrast as is consistent with the above conditions. Some interesting work is being done on transparent phosphor screens with high resolution attainable. However, as yet this is limited to certain phosphors, the screens are considerably lower in efficiency, and the tube cost is quite high.[10,11]

Fig. 5. Decay curves of P16 and P18 (Y) phosphors.

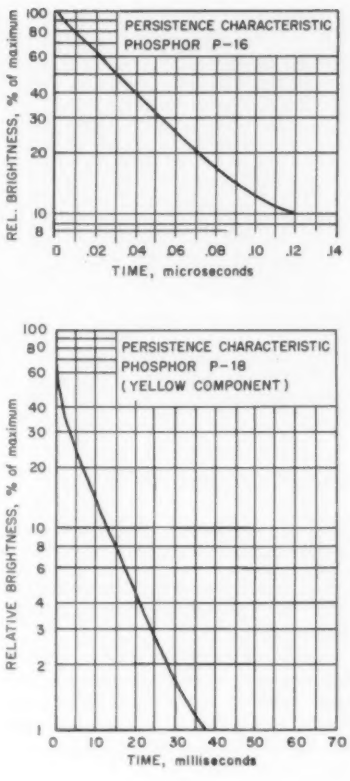


Fig. 6. Decay curves of P24 and P18 (B) phosphors.

Other Tube Requirements

Other factors that determine the quality of the light image coming from the tube are the glass envelope and the operating characteristics of the cathode-ray tube. The glass face must be free, as far as possible, of seeds, blisters, ripples, scratches, and weathered or etched areas. The tube is essentially part of the optical system. Depending upon that system, the face must be either flat or curved and may need to be ground and polished. If the tube is to be operated much above 20 kv, the glass may have to be nonbrowning so that the x-rays emitted from the phosphor on excitation will not discolor the glass layer or face. The glass can be gray or clear. If the tube is used in the absence of ambient light, it is somewhat more preferable to have it clear since the increased light transmission is desirable, and there is a negligible increase in contrast due to the neutral gray filter effect.[7]

Another problem often encountered is one of halation due to the multiple internal reflections of light from the inner and outer surfaces of the glass. In this case a curved face is preferable to a flat surface, and thin glass is preferable to a thick glass face to minimize the halation effect. It is important to note in this respect that a flat face on a tube usually requires a thicker face to withstand external pressure after evacuation. Consequently a large tube, of say 10 in. in diameter, will have a considerably thicker face if it is flat than if there is some radius of curvature. The latter, all things being equal, will exhibit less halation (see Fig. 2).[12]

The deflection angle of the bulb is important in that it is easier to maintain more uniform spot size from center to edge of the face using narrower deflection angles. Since it is important to keep the resolution high in the corners as well as in the center, it is desirable to have spot-size control in both areas.

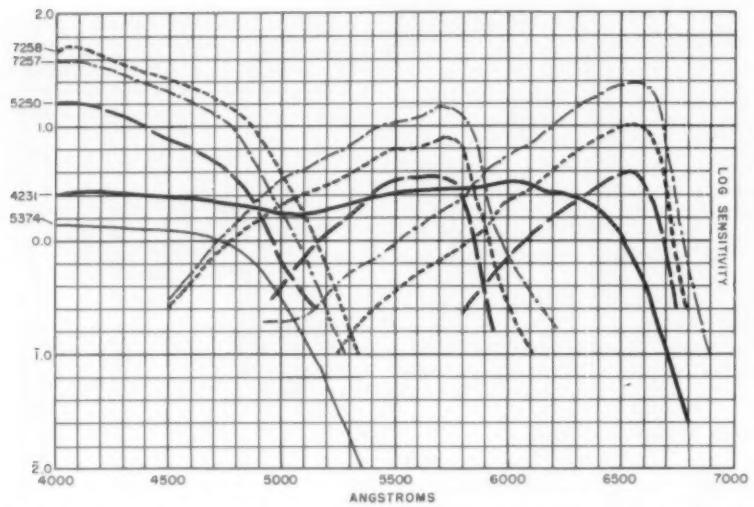


Fig. 7. Spectral sensitivities of various Eastman Kodak Co. TV Recording Films. (To compare with film curves in millimicron units: 10,000 Angstrom units equal 1,000 $m\mu$.)

This is why most of the film recording tubes have a comparatively small deflection angle.

Finally, a tube exhibits its own gamma characteristics. This is the relation of the input drive to the output brightness. This is not uniformly linear throughout the whole operating range in a cathode-ray tube.[13]

The general law showing the relationship between fluorescent[14] output and energy input may be expressed as:

$$L = f(i)(V - V_0)_n$$

where:

L = light output,
f = a constant,
i = current,
V = accelerating voltage applied,
V_0 = "dead" or threshold voltage (varies with phospher),
n = a constant that ranges from 1 to 3.

The screen thickness, screen porosity and screen "charging" also affect the voltage-light output relationship. It was already pointed out that light output vs. current is not uniformly linear. In the case of sulfide screens, current saturation effects are quite critical at high-current densities.

The Film

The choice of film and the determination of optimum film exposure[3] are determined by many factors, such as:

(1) Spectral emission and decay characteristics of the phosphor.
(2) Brightness of the phosphor screen.
(3) Spectral sensitivity of available film.
(4) The cost of the film.
(5) The processing conditions.
(6) The requirement for prints, and the final application of the finished product.

Figure 7 shows the spectral sensitivity of the more commonly used Eastman films. These curves represent average manufactured product and may change in the future.

The problem that is most difficult to treat is that of reciprocity law failure. The reciprocity law states that *Exposure* = *Intensity* × *Time*. In other words, the exposure is really a function of the light input times the time of exposure. If this law were to hold, 100 ft-c for $\frac{1}{10}$ sec would give the same exposure as 1 ft-c for 10 sec. However, this law does not hold, especially at the high intensities used, and the writer has not as yet seen an adequate explanation for this failure.

The problem that occurs in film recording is that instead of exposing the film with a comparatively low-intensity light for a long period of time, it is exposed with a very small spot of high-intensity light traveling very rapidly. There seems to be some disagreement among those engaged in this field as to whether to use comparatively slow film with a very high intensity cathode-ray-tube light output or faster film with a somewhat lower intensity light output.

Another problem that enters into this situation is one of the shutter system. Figure 8 is a comparison of three major shutter systems used. This problem is caused by the fact that photographic film in a motion-picture camera is exposed at the rate of 24 frames/sec while the television raster repeats at the rate of 30 frames/sec.[3] In order to record a program it may be necessary to expose the film to two television frames in a system where the bottom half of a film frame is exposed, then a full TV field is interlaced, and then the top half of the film frame is exposed before pulldown. If conditions are not just right, the line on the film where these halves meet is noticeable. This is called a shutter bar. Furthermore, the bottom half can have a different density from that of the top half. This may be due to the fact that the first or bottom half with its full phosphor decay remains exposed on the film during the whole cycle while the top half is cut off before its full decay period is over. Perhaps this is why some people prefer to use a somewhat slow film.

It has also been noticed that the shutter bar effect is decreased if a large *f*-stop on the lens is used. This is possibly due to a larger optical crossover area with the shutter giving more of a vignetting effect.[15]

Summary

In the above we have tried to point out some of the many complex factors entering into the film recording process. The cathode-ray tube is one of the most important units in this process and it must not only be made to high quality standards, but also must be reproducible to an exact degree. Development is continuing even further to improve the

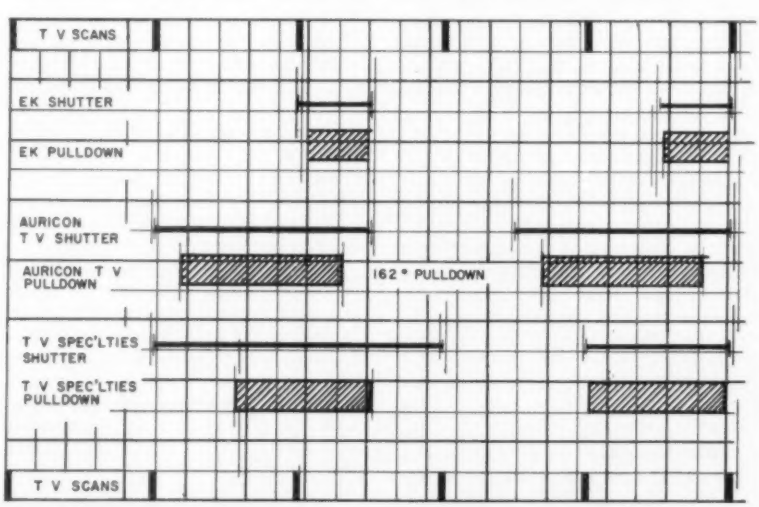


Fig. 8. Shutter systems.

characteristics of various TV recording tubes (Fig. 9). Obviously it would be impossible to control the whole system with its many variables without a highly dependable cathode-ray tube as well as adequate film, adequate optical systems and good electronic circuitry.

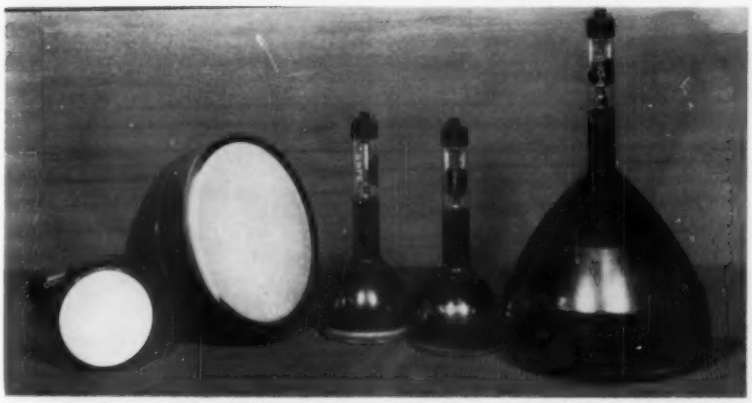


Fig. 9. Continental TV recording tubes 5CUP11, 10NP11, 5WP11, 5CUP18, C10-6P11.

References

1. P. J. Herbst, R. O. Drew and J. M. Brumbaugh, "Factors affecting the quality of kinerecording," *Jour. SMPTE, 58*: 85–104, Feb. 1952.
2. A. Abramson, "*Electronic Motion Pictures*," ch. 9, p. 112, University of California Press, Berkeley, 1955.
3. H. W. Chinn, "*Television Broadcasting*," pp. 409–433, McGraw Hill Book Co., N.Y., 1953.
4. H. Leverenz, "*An Introduction to Luminescence of Solids*," p. 433, John Wiley and Sons, N.Y., 1950.
5. M. Sadowsky, "The 'double layer' projection tube screen for television," *Proc. IRE, 38*: 496–498, May 1950.
6. M. Sadowsky, "Preparation of luminescent screens," *Jour. Electrochem. Soc., 95*: 112–128, Mar. 1949.
7. D. W. Epstein and L. Pensak, "Improved cathode-ray tubes with metal-backed luminescent screens," *RCA Review, 7*: Mar. 1946.
8. M. Sadowsky, U.S. Patent 2,644,770.
9. M. Sadowsky, U.S. Patent 2,625,493.
10. Frank J. Studer, "Grainless phosphor screens for TV tubes and a light amplifier," *Jour. SMPTE, 65*: 197–200, Apr. 1956.
11. A. E. Hardy, "Powder and transparent phosphor screens under high ambient illumination," *Electrochem. Soc. Electronic Div. Abstract, 9*: No. 1; 85–88, May 1960.
12. R. R. Law, "Contrast in kinescopes," *Proc., IRE*: Aug. 1939.
13. R. D. Gold, "Drive factor and gamma of conventional kinescope guns," *RCA Review*, Dec. 1958.
14. P. Pringsheim and M. Vogel, "*Luminescence of liquids and solids*," p. 29, Interscience Publishers, N.Y. 1946.
15. R. Springer, *Private Communication*, Station KABC-TV, Los Angeles.
16. *Note*: Phosphor curves derived from: "Optical characteristics of cathode-ray tube-screens" JEDEC Publication No. 16, June 1960 (Electronic Industries Association).

Video-Tape Analyzer

By A. A. GOLDBERG and M. R. HANNAH

The Video Tape Analyzer is used in the production of video tape and conveniently measures these tape parameters: (1) number and characteristics of dropouts; (2) comparative frequency response; (3) comparative noise figure; (4) comparative sensitivity and output level; and (5) ability of tape to resist mechanical abrasion. Since the VTA neither records nor stores picture information, analysis is accomplished during one run-through of the tape; therefore tape handling is reduced, analysis time is decreased, and no synchronizing circuitry is necessary. The VTA's operation is described.

VIDEO TAPE RECORDERS, introduced early in 1957, were immediately accepted by the television broadcasters. However, it soon became apparent that significant improvements would have to be made in the magnetic tape before high-quality picture reproduction could be obtained consistently.

After the initial enthusiasm wore off, the industry was confronted with the problem of procuring acceptable magnetic tape. The broadcaster depended entirely on a subjective evaluation that he found difficult to define quantitatively. Not having one of the originally scarce video-tape recorders (VTRs), the tape manufacturer depended on the broadcaster for tape testing. This slowed down the process of feeding back performance data to the tape development groups who were handicapped by the long wait.

The CBS/3M Video Tape Analyzer (VTA), Fig. 1, was built to provide the tape manufacturer with a means for conveniently measuring the physical and electrical parameters of the tape insofar as they affect the performance of a recorder.

Performance Objectives

A means had to be provided for measuring (a) the tape frequency response, (b) the tape noise contribution, (c) dropouts and (d) the rate of wear and decline in picture quality resulting from repeated plays. The most accurate analysis would be obtained if the tape was subjected to electrical and mechanical stresses equivalent to those imposed by a recorder. The VTA therefore, was not required to store and reproduce picture information. This fact permitted faster analysis with less tape handling and the elimination of synchronization circuitry. It was decided that the VTA should record and reproduce video signals almost simultaneously, thus allowing the analysis to be done during one pass of the tape.

In the initial stages of the development it was not known what parameters were most significant. As a result, the VTA incorporated a broad scope of measurements. Many of these were later found to be of secondary importance.

In the interest of good correlation it was decided that the VTA would employ a revolving drum assembly similar to that of the recorder but modified for instantaneous playback. To accomplish this, the first head records a transverse track which the second (following) head plays back. The cycle is repeated with the third and fourth heads. Thus, heads 1 and 3 are always recording and heads 2 and 4 are always reproducing. As will be shown in greater detail later, this can be accomplished by displacing the reproduce heads downstream relative to the record heads.

Two modes of record-reproduction are provided; an FM mode similar to

Presented on October 9, 1959, at the Society's Convention in New York, by A. A. Goldberg and M. R. Hannah (who read the paper), CBS Laboratories, High Ridge Rd., Stamford, Conn. (This paper was received on January 31, 1961.)

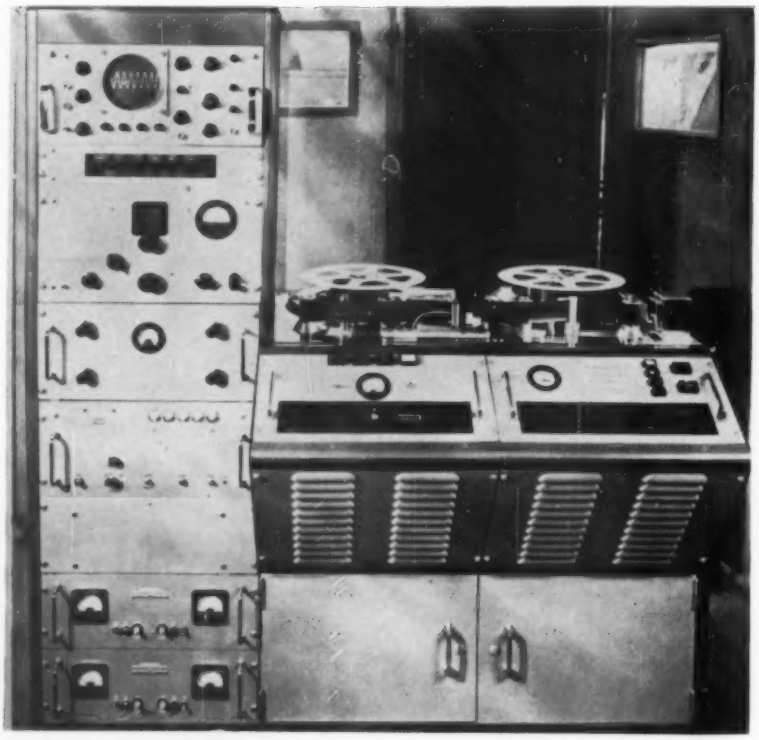


Fig. 1. Video Tape Analyzer.

standard VTR operation, and a direct mode that is useful for determining the frequency response of the tape.

In order to prevent unwanted cross-talk, the record and reproduce channels are gated sequentially so that the record signal is applied only when a record head is in contact with the tape. Similarly, the reproduce channel is activated only when a reproduce head is on the tape.

The Video Tape Analyzer has been designed to provide measurement facilities as follows:

(a) The tape frequency response is measured by recording and reproducing a variable-frequency signal adjustable from below two megacycles to above eight megacycles.

(b) The noise generated by the tape is measured by recording, reproducing and demodulating an unmodulated FM carrier generated within the VTA. The measurement is a relative one wherein a meter reading is compared with that obtained from a previously measured tape sample of known and acceptable quality. It should be noted that all noise, including gross contributions such as dropouts, will be measured.

(c) Dropouts are detected when an unmodulated carrier is recorded, reproduced and demodulated. Limiting gate circuits provide means for determining the width and amplitude characteristics of dropouts. A built-in electronic counter indicates the total number of dropouts during a given time period or tape length. Dropouts are also presented on the face of an external television raster as a series of white streaks. This visual display is useful for subjective evaluation.

(d) A tape sample of any desired length can automatically be made to pass repeatedly through the VTA, and the dropout counter indicates a total at the end of each pass. The rate of increase of the dropout count and noise meter reading is an indication of the rate of decline of tape quality with repeated record-reproduce cycles. The record and rewind transport of the tape requires a minimum of attention by the operator when making the measurements.

(e) A filter in the vacuum cleaning facility collects the debris from the tape for inspection and analysis.

Rotating Drum and Track Specifications

The drum assembly used in the VTA is similar to the one used in a recorder, but with a modification in the positions of the magnetic heads. The rotating drum is a disk approximately $6\frac{1}{2}$ in. in circumference. Spaced 90° apart on the periphery of the drum are four heads, each connected through slip-rings to the external circuitry. The combined rotational drum motion and linear tape motion results in a series of bands of magnetization across the tape surface. As shown in Fig. 2, the record heads are displaced 0.005 in. to the left and the reproduce heads are displaced 0.005 in. to the right.

The drum rotates 240 revolutions/sec. When the tape moves at a speed of 9.6 in./sec. a track pattern as shown in Fig. 3 is produced and perfect tracking is obtained.

Referring to Fig. 3, note that the active width of the tape is 1.63 in. Record head 1 writes track I; 1/960 sec later reproduce head 2 is ready to read track I. Since heads 1 and 2 are displaced longitudinally 0.010 in. apart, the tape must move 0.010 in. in 1/960 sec or at a linear speed of 9.6 in./sec. The record and reproduce sequence of heads 1 and 2 is repeated by heads 3 and 4. This results in a tape magnetization pattern of transverse recorded bands 10 mils wide alternating with 10-mil guard bands. Thus 50% of the active tape area is analyzed as compared with the 66% recorded in a VTR.

Description

Figure 4 is a simplified block diagram of the CBS-3M Video Tape Analyzer. In the FM mode of operation, the signal generator provides video frequencies which modulate an FM carrier. The signal generator can also be used as the direct source for measuring the frequency response of the tape. Either the signal generator output or the modulated FM carrier is introduced into a gated record amplifier which is turned ON for 1/960 sec during record and OFF during the following 1/960-sec reproduce period. Two separate record output amplifiers are each connected to a record head via slip rings.

The reproduce magnetic heads are connected to separate preamplifiers whose outputs are mixed and gated ON and OFF in the gated reproduce amplifier. The gated, reproduced signal is amplified, limited and demodulated in the limiter-demodulator. The output is a video signal.

The reproduced video signal is analyzed in three devices: (a) a dropout analyzer, (b) a picture monitor screen and (c) a noise analyzer.

Demodulator

The FM carrier has a center frequency of 5.5 mc. Significant sideband energy exists between 2 and 8 mc and all carrier signal circuits are designed to pass this spectrum.

The demodulator contains a chain of amplifiers which provide approximately 50 db of limiting before detection. The detector employs a delay line to provide a variable amplitude vs. frequency output, followed by a full wave rectifier to provide linear, wideband detection and easy removal of the carrier frequency.

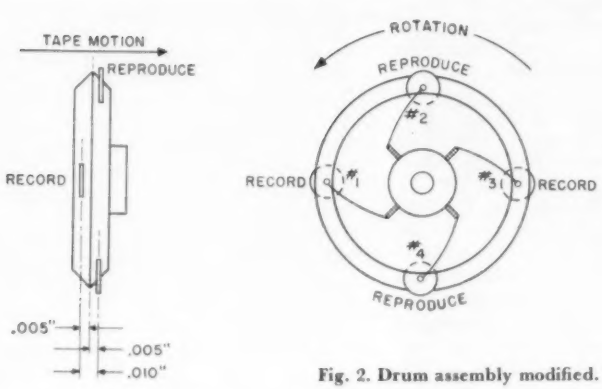


Fig. 2. Drum assembly modified.

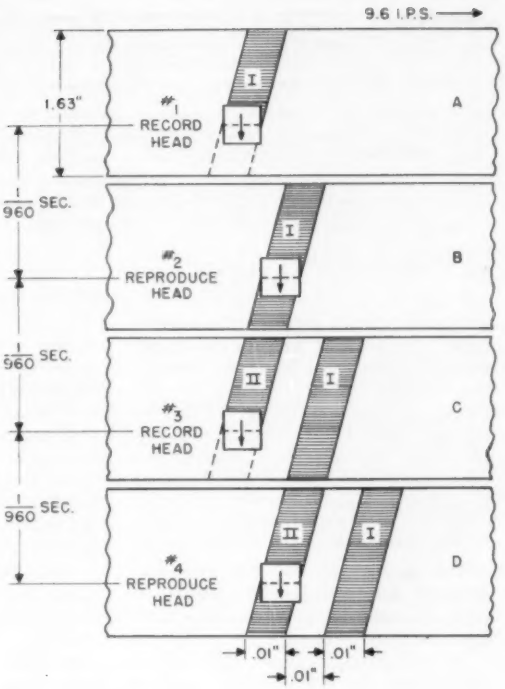


Fig. 3. Track geometry.

Dropout Analysis

Before describing the dropout analyzer, it may be well to define the term "dropout" as it applies to video-tape recording. Dropouts are random noise flashes associated with tape imperfections. In the reproduced video picture they appear as white or black flashes having durations of from a few microseconds to a horizontal period or more. The dropout occurs when a small area of tape provides no magnetic media and the carrier is momentarily interrupted. A VTR will show this as a black and white flash of which the white is more objectionable. During the absence of carrier, the system noise increases. A dropout can be considered as a burst of noise rather than a wide pulse.

A simplified block diagram of the demodulator and analyzer is shown in Fig. 5. For dropout analysis, the noise burst is detected by a diode whose reverse bias is adjustable to provide the calibrated amplitude gate, the output of which is amplified and clipped to form a pulse. This pulse is applied to a width gate consisting of a tube whose plate voltage rises exponentially at a rate determined by the calibrated time constant in its plate circuit. If the dropout pulse is of sufficient duration to hold the tube at cutoff until the plate voltage rises to a specific value, the pulse generator will be fired. Thus all pulse widths in excess of a selected value will generate an output.

During the record-reproduce transition time, extra pulses are generated which should not be counted. To eliminate these extraneous pulses, the output of the pulse generator is mixed with a blanking signal in the blanking mixer. This is followed by a trigger generator which provides uniform pulses to an electronic counter. Thus, the counter will totalize all dropouts having an amplitude greater than a value determined by the amplitude gate setting and having a duration greater than a value determined by the width gate setting. An in-line "Nixie" readout on the counter indicates the total number of dropouts which pass the limiting gates during a period of time corresponding to a specific length of tape.

It is desirable that means be provided to view dropouts on a picture tube in order to make a subjective evaluation. A 7-in. monitor is connected to the video output of the VTA. The vertical sweep rate is synchronized at 240 cycles and the horizontal is left free-running at 15 kc. This results in a raster that is divided from top to bottom into four equal parts, two record areas alternating with two reproduce areas. Since we are interested in viewing only the reproduce areas of the raster, the record areas are blanked optically and electrically. Good correlation with regular VTR performance can be obtained because the appearance of the dropouts is the same.

Noise Measurements

Noise is measured on a meter that provides a relative indication when compared to the reading obtained with a reference tape. During noise measurement, the FM carrier is left unmodulated.

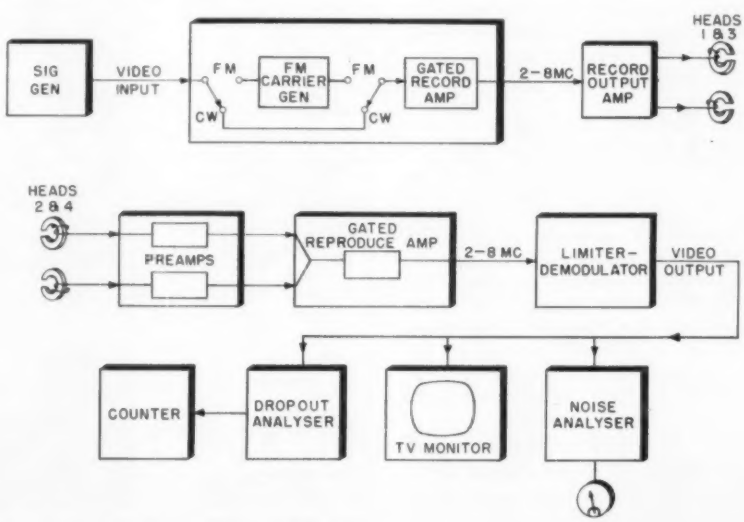


Fig. 4. Simplified block diagram of the V.T.A.

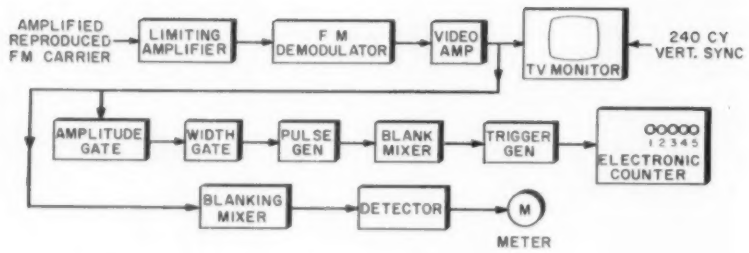


Fig. 5. Demodulator and analyzer.

Referring to Fig. 5, note that the demodulated video, which now consists of only noise and dropouts, is passed through the blanking mixer to eliminate the switching transients during the record-reproduce switchover. After further amplification, the noise is rectified in the detector and the resultant direct current is applied to a meter.

Gating and Blanking Generator

The gating and blanking generator provides the necessary waveforms to control accurately the sequential record-reproduce timing of the VTA.

A 240-cycle square wave, derived from the rotation of the drum, is used to sequentially gate the record and reproduce signals in phase opposition. Although the tape is 2 in. wide, the active width is 1.63 in. A phasing control in the gating generator sets the position of this active area.

Figure 6 is a simplified block diagram of the gating and blanking generator. A 240-cycle voltage (A) is generated by photoelectric means in the drum assembly and is multiplied four times by two successive frequency doublers to a 960-cycle signal (B). A phasing control prior to the first frequency doubler is used to shift the phase of this signal relative to the instantaneous angular position of the magnetic heads.

The 960-cycle signal (B) triggers a pulse generator whose output (C), in turn, is delayed 10 μsec by a delay multivibrator. This delayed 960-pulse/sec signal (D) is mixed with the 480-cycle sine wave from the first frequency doubler, and results in signals (E) and (F) which control the gate multivibrator.

This method of triggering the gate multivibrator is used because there is a definite relationship between the polarity of the 240-cycle drum signal and the position of the record heads on the tape. Doubling the 240-cycle signal to 480 cycles, and mixing it with the 960-cycle trigger pulse before it is applied to the gate multivibrator, ensures that the record gate signal (G) will always be ON when a record head is on the tape. Conversely, the reproduce circuit will be gated ON when a reproduce head is on the tape.

The 960 pps signal (C) is also used to trigger the blanking multivibrator whose output is a 20-μsec blanking pulse (I). This blanking pulse is used by the dropout analyzer to ensure that the record-reproduce switchover transients are not counted as dropouts. It may be noted that the switchover occurs within the 20-μsec duration of the blanking pulse.

Tape Deck

Figure 7 is a view of the tape deck and control panels. On the tape deck from left to right are:

(a) Supply reel that is controlled by a torque motor and mechanical brake.

(b) Supply idler.

(c) Continuously energized erase head. It should be remembered that the VTA does not store information; therefore, the tape being analyzed must always be erased prior to entering the drum assembly. The 2-in. high, double-gap head is driven by a 10-w push-pull power amplifier at approximately 20 kc.

(d) Drum assembly complete with motor and vacuum guide. 240-cycle, 3-phase power for the drum motor is obtained from a small motor-generator contained within the VTA.

(e) Audio head assembly. Two audio reproduce heads are positioned to contact the upper and lower $\frac{1}{4}$ in. of the tape width. Either or both heads may be switched into an audio amplifier and loudspeaker. These heads pick up

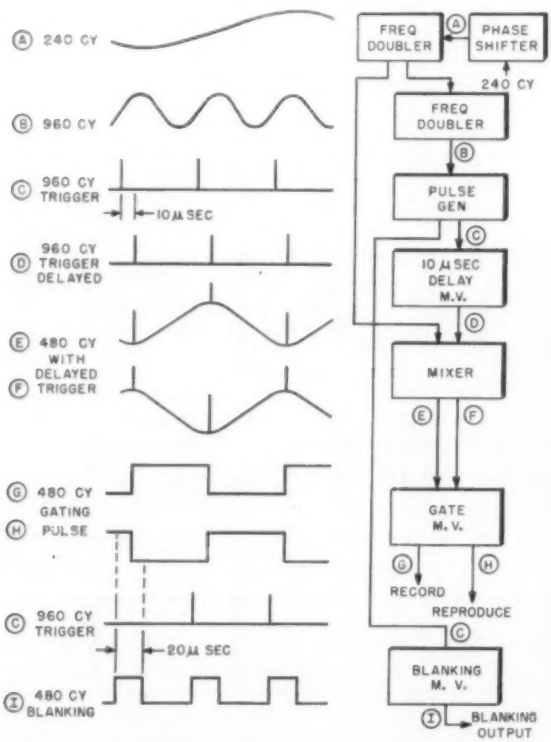


Fig. 6. Gating and blanking generator.

Fig. 7. Tape deck.

the transverse video tracks and produce a distorted 480-cycle tone which is useful for centering the video tracks on the tape. As the upper and lower audio head signals are alternately switched into the loudspeaker, the 240-cycle phase control can be adjusted until the video tracks are vertically centered on the tape.

(f) Capstan and pressure roller that pulls the tape at 9.6 in./sec. The pressure roller is solenoid activated only when the deck is in the record mode.

(g) Take-up idler. The swinging arm is connected to a switch that de-energizes the deck in case of tape breakage or at the end of tape.

(h) Automatic cycling sensor. During tape life testing, a given length of tape can be analyzed repeatedly with minimum attention from the operator. A small piece of reflecting tape is affixed to the beginning and end of the length of video tape being analyzed. These tapes are illuminated by an optical system and the reflected light is detected by cadmium sulfide photocells. The video tape is repeatedly played and fast-rewound; the number of cycles is recorded on a counter.

(i) Take-up reel with torque motor and brake.

The lefthand control panel contains the Stop, Record, Rewind, and Fast-Forward pushbuttons as well as the Record Level meter and controls. It also contains the automatic cycling counter and an elapsed time meter.

The righthand control panel contains a tape guide vacuum gage, loudspeaker, audio controls, gate phasing control and the main power switch.

Table I is a comparison between the VTA and a VTR when used for video tape evaluation.

It is interesting to note that, despite the slower tape speed, 22% less time is required for the VTA analysis because the tape is run through only once. Statistically, the 41% area analyzed by the VTA compares favorably with the 54% area of the VTR.

Table I. Comparison Between the VTA and a VTR When Used for Video-Tape Valuation.

	Track width, in.	Guard width, in.	Tape velocity, ips	Tape area recorded, %	Time to record and reproduce 2,250 ft of tape, min
VTA	0.010	0.010	9.6	41	47
VTR	0.010	0.005	15	54	60

The Video Tape Analyzer has been in operation at 3M for over two years and has been of considerable help in the improvement of video-tape quality.

Acknowledgments

We would like to ackhowledge Daniel Doncaster's contribution to the mechanical design of the VTA. Many others in 3M, the Ampex Corp., and in CBS Television have helped make this device a success.

Selection and Specification of Rear-Projection Screens

By PETRO VLAHOS

The characteristics of the rear-projection screen are examined in detail. Numerical constants are provided that define these characteristics for practical screens and convert foot-candles to footlamberts. A procedure is given by which an optimum screen may be specified for a specific application. Human factors are discussed and numerical values provided for viewing brightness and contrast for various types of projected material.

Introduction

A projection system normally employs a screen as one of its elements. Engineering data are available on most projection elements, such as lamps, lenses and projectors. However, very little quantitative diffusion data about projection screens is available. This lack of screen data poses a special problem in the design or development of a projection system. Unless the diffusion characteristics are known, screen selection can be made only by trial and error. Even after several trials there may remain a degree of uncertainty that the best choice has been made. Ordering and bidding are equally trying, since there is little choice but to specify "as per sample" or to specify by trade name.

Diffusion of light can be described and measured by certain physical and optical laws. These same laws apply to projection screens, and make it possible to measure and specify screen characteristics.

This paper examines the rear-projection screen in detail and provides numerical constants that define the diffusion characteristics for practical screens. These constants relate projection light to viewing brightness and provide specifications based on performance. A procedure is given by which the characteristics may be determined for an optimum screen for a specific application.

Rear-projection screens are used for motion-picture and television production, data display systems, viewers, film readers, instruments, and many other commercial and military applications. The choice of rear projection instead of front projection should be based on the need for free access to the viewing side, or placement limitations of the projection equipment. Both types of projection can be equally good or equally poor, depending on how the characteristics of the selected screen fit the requirements of the application. However, it is much easier to obtain poor results with rear projection because of the wide range of possible diffusion characteristics. On the other hand, the wide choice of characteristics does permit, in some applications, improved contrast, larger or brighter pictures, or economies in projection light. A particular screen characteristic — such as low reflectivity for daylight viewing, or high gain where projection light is meager — may well be the answer to a special problem or requirement.

The function of a projection screen is to accept incident illumination from the projector and to diffuse and re-radiate the illumination as a visible image. The conversion of incident illumination to visual brightness may be expressed by numerical constants. To determine that adequate viewing brightness will be obtained, it is necessary to know how much brightness is adequate and how much light is incident. Practical numbers are provided for incident illumination and viewing brightness.

Projection Fundamentals

The terminology employed in illumination is not as self-defining as might be desired.[1] Without further apology a few

Released as of December 15, 1960, as Technical Memorandum 571 of System Development Corp., as a contribution to the *Journal* by Petro Vlahos, Engineering Dept., System Development Corp., 2500 Colorado Ave., Santa Monica, Calif.

Table I. Lumen Output of Projectors Representative of Current Manufacture.

The lumen output figures shown do not necessarily represent average values, but are typical for projectors of good design having the same lamp wattage, aperture dimensions, lens focal length and "F" ratio. These lumen ratings are suitable for preliminary calculations; however, the actual lumen output for a specific projector should be measured or obtained from the manufacturer.

300-w Lamps	Lens: 4″ f/3.5	5″ f/3.5	5″ f/2.8	7″ f/3.5
17.5 × 23 mm	140	140	165	135
23 × 34 mm	300	305	365	300
26.2 × 38 mm	400	415	480	410
38 × 38 mm	600	565	630	555

500-w Lamps	Lens: 3″ f/3.5	4″ f/3.5	5″ f/3.5	5″ f/2.8	7″ f/3.5
23 × 34 mm	325	425	415	525	500
26.2 × 38 mm	—	480	530	610	590
30 × 30 mm	350	460	480	575	530
38 × 38 mm	—	—	705	750	840

750-w Lamps	Lens: 5″ f/3.5	5″ f/2.3	7½″ f/4.0	11″ f/3.7
23 × 34 mm	830	1190	650	795
26.2 × 38 mm	1075	1540	840	1030
1000-w Lamps				
23 × 34 mm	1150	1720	835	1075
26.2 × 38 mm	1490	2230	1080	1390

8mm Motion Picture
300-w Lamp — 0.75″ f/1.6 lens 36
500-w Lamp — 0.75″ f/1.6 lens 45
500-w Lamp — 1.00″ f/1.6 lens 85

16mm Motion Picture	Lens: 2″ f/1.6	3″ f/2.0	4″ f/2.5	
750-w Lamp	200	150	97	(3-blade shutter)
	290	220	145	(2-blade shutter)
1000-w Lamp	265	190	130	(3-blade shutter)
	390	280	190	(2-blade shutter)

Professional 16mm — Lens: 2″ f/1.6 to 4″ f/1.6 with matching condenser

Strong Arc Lamp, 46 amp — 2000 (with heat filter for B & W films); 2500 (without heat filter for color films)

essential terms will be explained. The intensity of projected light incident upon the screen is determined by sampling a small area with a light meter calibrated in foot-candles. The foot-candle meter must be held on the projector side of the screen with its photosensitive surface facing the projector, but parallel to the screen surface. The meter should be held against the screen or, even better, in the screen plane. The reading obtained represents the intensity of incident light in foot-candles at the point of measurement. It will be found that the incident light is not uniformly distributed, but falls off at the sides and corners. A 70% distribution is typical, representing the intensity at the sides of the screen as compared to its center.

The total light incident upon the screen is the product of the average illumination in foot-candles and the illuminated area in square feet, and is expressed as "lumens":

Total light (lm) =
Avg. illumination (ft-c)
× Illuminated area (sq ft)

While sophisticated methods exist for determining average illumination,[2] a simple average of three foot-candle readings at left, center, and right is sufficiently accurate for use in screen selection. The side readings should be taken in from the edges about 5% of the picture width. The lumen figure determined above represents the total light output of the projector. This rating is a characteristic of the optical train of the projector and is independent of the size of the picture or the projection distance. It is determined by the wattage, age and brightness of the lamp; the collection efficiency of the lamp optics; the size of the film aperture; and the characteristics of the projection lens. The lumen output rating of a projector is as significant as horsepower rating is to a motor. Lumen output ratings may be obtained from the projector manufacturer, or measured as indicated above. Table I lists the projector lumen output for several typical projectors. For a given picture size, average illumination may be determined as follows:

Avg. incident illumination (ft-c) =
Projector output (lm)/Picture size (sq ft)

A numerical value for incident illumination is required because the final viewing brightness to the observer is the product of the incident illumination and the diffusion constant of the selected screen.

A projection system built around a specific projector may result in either too much or too little projection light. Excess light may be reduced with little difficulty. Reduction of lamp wattage, neutral filters, lens stops or low efficiency screens are effective. It is somewhat more difficult to increase insufficient projection light. Camera experience would indicate that more light could be obtained by the use of a larger lamp or a "faster" lens (lower *f*-number). But a projector does not behave as a camera in reverse, and neither method guarantees a proportional light increase.

A projector optical train consists of the lamp optics, the film aperture, and the projection lens, representing three optical "stops." One or more of these stops represents a stop for the system. In the 8mm projector, for example, the film aperture is frequently the system stop. The use of a larger lamp, in this instance, would produce a larger circle of illumination on the aperture; but very little additional light would pass the aperture to reach the screen. Similarly, an *f*/1.8 lens should be expected to deliver four times the light of an *f*/3.5 lens. A lantern slide projector, however, may not provide a cone of light sufficient to fill an *f*/1.8 lens. A projector is a coordinated design, and it is often necessary to alter two elements of the optical train to realize a major increase in lumen output. The lumen output figures in Table I show about the maximum that can be expected from equipment having similar lamps, lenses and apertures.

Human Factors

A projection system presenting a display to a human observer is most effective when the needs and limitations of the observer are considered. Maximum and minimum brightness, persistence of vision, flicker, color perception and color saturation, ambient illumination, contrast, and readability all play a part in arriving at an effective presentation.

The human eye can tolerate and adjust to an extremely wide range of brightness levels. Under a given illumination, however, the maximum brightness range is determined by the reflectivity and specularity of objects. This range is essentially limited to a ratio of about 25 to 1, representing the reflectivity of white, (100%) compared to the reflectivity of black (4%) (highlights from polished metalic surfaces extend this range). This ratio holds for any given illumination within the tolerance limits of the eye, whether the illumination is 10 ft-c or 1000 ft-c. Given this ratio, a projected image may,

of course, be viewed at high or low brightness levels. Projector limitations and ordinary economics make the lowest acceptable brightness of primary interest.

The brightness at which projected images are viewed is defined by the American Standards Association as that screen brightness obtained with the projector running without film in the projector aperture. This condition is also referred to as "open aperture" screen brightness. All references to screen brightness in this paper refer to open aperture brightness. Although the term "brightness" is generally being replaced with the term "luminance," most of the references refer to brightness. In any event, it is the physiological response of the human eye to light.

The unit of brightness is the foot-lambert. Brightness, a physiological response, is independent of viewing distance. As distance increases, an object may appear to become smaller, but it maintains its brightness until the object is so small that its entire image falls on a single rod on the retina of the eye. Brightness measurements require the use of a brightness meter, the response of which is also independent of distance. Exposure meters, light meters, and foot-candle meters are not suited for this purpose.

The minimum acceptable open aperture screen brightness for viewing black-and-white or color pictures in a darkened room is 5 ft-L. Lower levels are often tolerated, but are rarely considered acceptable. Large outdoor theater screens seldom exceed a brightness of 2 to 3 ft-L. At brightness levels below 5 ft-L, colors appear dull and unsaturated. At 1 ft-L, it is difficult to distinguish color from black and white.

The minimum acceptable brightness for viewing is the same for still or motion-picture projection. The upper limit of brightness is somewhat lower for motion pictures than for stills. Motion-picture projection at 24 frames/sec with two bladed shutters produces a 48-cycle flicker rate. The eye is most sensitive to flicker at about 8 cycles/sec but is relatively insensitive to flicker at 48 cycles. The threshold of flicker perception is determined by both rate and brightness. At the 48-cycle rate the flicker threshold is approximately 20-ft-L. Above 20 ft-L, the persistence of vision is insufficient to span the time lapse between light pulses, and images appear to flicker.

The American Standard (ASA PH 22.39-1953) for screen brightness specifies 9 to 14 ft-L as a good range for viewing motion pictures. The present trend to higher quality has resulted in a proposed standard of 16^{+4}_{-6} ft-L.

A practical guide to screen brightness for viewing motion pictures may be defined as follows:

5 ft-L: minimum (marginal for some observers),

10 ft-L: satisfactory,

15 ft-L: excellent, and

20 ft-L: maximum (flicker threshold for some observers).

The above figures apply to a darkened room. Room light, although carefully shielded from the screen, can cause an apparent loss of screen brightness by limiting retinal sensitization of the eye.

The need for room darkness to prevent ambient light from reaching the screen depends to a large extent on the subject matter projected. Although an average pictorial scene may not exceed a brightness range of 25 to 1, highlights from specular surfaces extend this range to 100 to 1. The specular highlight of a day scene, compared to the black of a night scene, can cover a brightness range of 1000 to 1. To conserve the full range of pictorial detail, non-image screen brightness should not exceed 0.02 ft-L.[3]

Non-image brightness results from illumination of the screen by all light sources other than from the projection lens. For nontheatrical projection, night scenes are rarely used and the non-image brightness resulting from ambient light may be one one-hundredth of the open aperture screen brightness. Non-image screen brightness is the product of ambient light falling on the screen (in foot-candles) and the screen reflection factor. The reflection factor may be considered as 0.85 for all types of front projection screens. The reflection factor for rear projection screens varies from about 0.05 to 0.5. Specific values are provided in the discussion of rear-projection screen characteristics.

Still projectors do not normally employ shutters, and therefore the upper limit of screen brightness is not limited by flicker. For full range pictorial scenes, high brightness enhances color saturation and the ability to see detail in darker areas of the scene. The projection of slides or stills often occurs in surroundings where the control of ambient light is difficult. Under these conditions the problem is to obtain sufficient screen brightness to maintain adequate contrast. The degree of contrast required depends on the subject matter.

Pictorial scenes require a contrast (image brightness to non-image brightness) of 100 to 1. A contrast of 25 to 1 is sufficient for good legibility of printed characters or line work. Projection of negative material (white letters on a black background) has maximum readability at a contrast ratio of 5 to 10. High contrast should be avoided when projecting negatives of data tables. The white letters against the dark background produce an effect called "dazzle," in which the bright letters and numerals simulate light sources. The dazzle effect seriously reduces readability. Dazzle may be eliminated by reducing screen brightness or by reducing the contrast. Deliberate flooding of the screen with room light is a simple technique to eliminate dazzle.

The open aperture screen brightness for still projection[4] should be greater than the non-image screen brightness by a factor of 5, 25 or 100, depending on the type of material projected.

Screen Characteristics

A portion of the incident light on a rear-projection screen is reflected, a portion is absorbed, and the balance is transmitted. The reflected portion is of interest since this component reduces the total light available for creating the visable image. Reflection also causes loss of picture contrast from ambient light. The absorbed component reduces efficiency, image brightness, and reflection. The transmitted portion is subjected to diffusion and scatter and is responsible for the visible image. Variations in reflection, absorption and diffusion determine the constants that define the characteristics of rear-projection screens.

Screen Gain and Bend Angle

The concept of "gain" arose from early experience with front-projection screens. The first screens were white non-glossy surfaces, such as flat white paint, fabric or plaster. These non-glossy "matte" surfaces provided brightness of 0.85 to 0.90 ft-L for each incident foot-candle of illumination. The later beaded and silver screens were brighter than the white screens (at certain viewing angles) and this increase in brightness was referred to as "gain." The term "gain" therefore implies comparison to standard reference white. An ideal reference white would reflect 100% of the incident light and diffuse perfectly to provide the same brightness from all viewing angles. This ideal diffusing surface, as proposed by Lambert, would provide 1 ft-L of brightness for each foot-candle of incident illumination. White plaster, white chalk and magnesium carbonate are almost perfect Lambert diffusing surfaces. If a perfect diffusing surface is defined as having a gain of 1.0, then gain may be defined as the ratio of observed brightness in footlamberts to incident illumination in foot-candles:

$$\text{Gain} = \text{Footlamberts/Foot-candles}$$

This notation or definition of gain applies to both front- and rear-projection screens. Practical screens do not have a constant gain. If a small area of the screen is observed, it is found that the brightness decreases as the observer moves from a central viewing position to a side viewing position. A diffusing screen is a passive element and does not add energy to the light that passes through it. Any increase in gain above unity for one viewing position must necessarily result in a gain less than unity for some other viewing position.

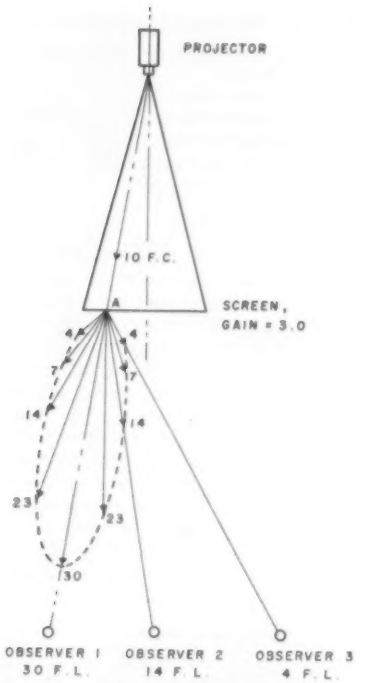


Fig. 1. Brightness distribution lobe for screen gain of 3.0.

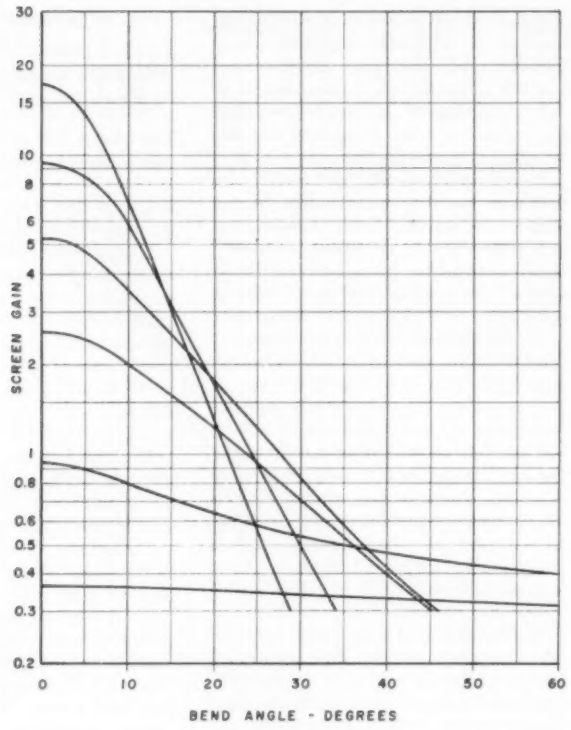


Fig. 2. Screen gain at various bend angles for several typical screens.

The behavior of a typical rear projection screen is illustrated in Fig. 1. This figure shows a projector, a screen and three observers. A light ray is shown incident upon the screen at point *A*. Continuation of the line representing the incident ray establishes the "principal axis" of the diffusion lobe. The incident light ray, partially diffused by the screen, spreads symmetrically about the principal axis. The incident light was arbitrarily adjusted to 10 ft-c to obtain the measured data in Fig. 1. The observed brightness of point *A* from any direction is indicated by the length of the arrow. Arrows are shown 10° apart. Observer 1, located on the principal axis, will perceive point *A* to have a brightness of 30 ft-L. Peak screen gain is therefore 3.0, the ratio of footlamberts to incident foot-candles. The brightness for observers 2 and 3 will be less than the peak since they are located off the principal axis. Any light reaching observers 2 and 3 must deviate from the principal axis by an angle determined by the position of the observer with respect to the principal axis. This angle is the "bend angle." The bend angle, therefore, depends upon the position of the observer with respect to the principal axis in question. The diffusion characteristics of several screens are shown in Fig. 2. Gain is plotted as a function of bend angle. The curves were obtained by measurement of actual practical screens.

Transmission, Diffusion and Reflection

One of the objectives in screen manufacturing is to select materials with a good light transmission capability to hold absorption losses to a minimum. Transmission has been used for many years to specify rear-projection screens; however, it is not a good index of performance, nor does it provide reliable information regarding the gain of the screen or its brightness distribution.

One method of manufacturing a rear-projection screen consists of spraying a clear ethyl cellulose or similar material onto a flat backing until the thickness is adequate for mechanical strength. After the coating has set, it is pealed off the backing, trimmed to size, and reinforced at the edges with tape and grommets. While the plastic material is clear, the two surfaces are rough (as a glass which is ground on both faces). The roughened surfaces provide a moderate diffusion of light with high transmission (85 – 90%). The degree of diffusion produced by this technique is limited, and for most purposes greater diffusion is required. The addition of white or other diffusing pigment to the liquid ethyl cellulose results in greater diffusion of the light, and also increases reflection.

It is important to note that diffusion provided by a clear plastic material, with rough surfaces, is caused by a change of direction of a light ray at each surface due to the relative incident and exit angles, and the refraction index of the plastic. There are little or no internal reflections. This type of screen is, therefore, non-depolarizing and can be used with polarized light, as in three-dimensional projection. The addition of white pigment to increase diffusion causes depolarization and makes the screen impossible to use with polarized light.

As more pigment is used, the reflection factor and diffusion are increased and the transmission is correspondingly reduced. At one point, reflection and transmission are equal and the screen may be viewed equally well from either side. Further addition of white pigment results in a white screen for front projection.

Another technique of screen manufacture consists of coating one side of a clear substrate, such as glass, Plexiglas, or flexible plastic, with a suitable diffusing layer. The diffusing layer is a pigmented carrier consisting of resins and solvent. The pigment may be any finely ground material having a different (generally higher) index of refraction than the carrier. High-index ground glass, titanium dioxide and similar materials have been used. The technique of coating only one side of a transparent backing is particularly effective in obtaining the fine grain and high resolution required for very small screens.

Figure of Merit

The wide variety of materials and diffusion techniques employed in screen manufacture produces screens of varying quality. The question arises, "How can the quality of one screen be compared to the quality of another?" Since the primary purpose of a rear-projection screen is to cause diffusion with minimum light loss, the bend angle that can be attained before the gain has fallen to one-half its peak constitutes a measure of quality, or "figure of merit."

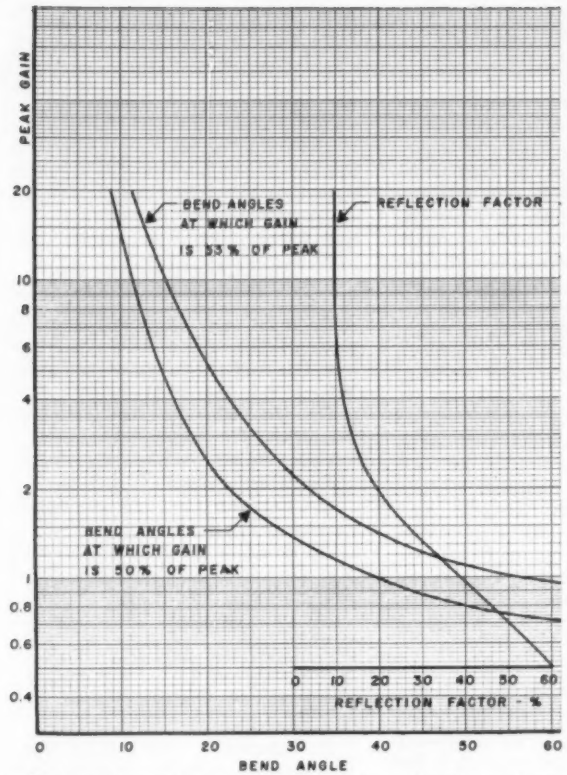


Fig. 3. Bend angles for 50% and 33% gain, and reflection factor vs gain.

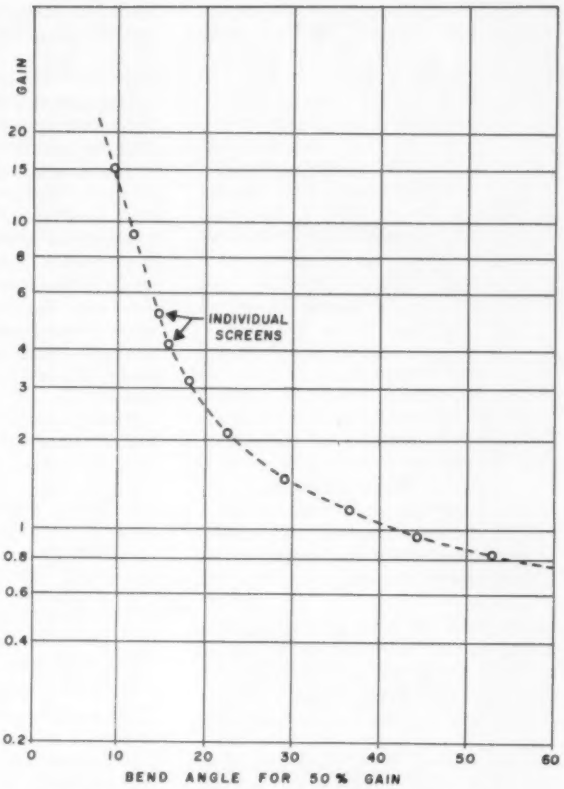


Fig. 4. Peak gain and bend angle at which gain is 50% of peak.

The measurement of a large number of screens shows a consistent relationship between the peak gain and a bend angle at which the gain is 50% of the peak gain. When the gain is high, the bend angle for 50% gain is small; and when gain is low, the bend angle for 50% gain is large. This relationship can be shown on a graph (Fig. 4) where the *y*-axis represents peak gain, and the *x*-axis represents the bend angle at which gain is 50% of peak. Thus, the peak gain and the angle for half gain are represented by a single point on the graph for each screen measured. A smooth curve can be drawn through all the points plotted. The fit is remarkable when all the screens measured are from a single manufacturer. The same process may be used to plot points representing the angle at which the gain is one-third of peak gain.

Figure 3 includes curves for 50% gain, for 33% gain, and for reflection factor. Any horizontal line that one may draw in Fig. 3 represents, within the limits of the graph, four characteristics of a single screen: (1) peak gain, (2) bend angle for 50% gain, (3) bend angle for 33% gain and (4) reflection factor. The data in Fig. 3 represent average characteristics and were obtained by measuring a large number of screens. The relative efficiency of a screen may be determined by measuring gain and angle for half gain, and by plotting the new data as a point in Fig. 3. If the point falls to the right of the 50% gain curve, the screen's efficiency is higher than average. If the point falls to the left of the 50% curve, its efficiency is lower than average.

Low efficiency screens are commercially available, and they are useful for special applications where ambient light is high. The low efficiency (black) screens incorporate a black or gray pigment to lower the reflection factor. Unfortunately, the dark pigment also absorbs projection light and reduces gain and picture brightness. The principal application of the black screen is in daylight viewing of relatively small pictures. The low reflection factor reflects very little of the room light and therefore maintains good picture contrast even in well lighted rooms. The addition of black pigment is equivalent to reducing peak gain without increasing the bend angle. For example, a black screen had a measured peak gain of 3.5, a bend angle of 10° for 50% gain, and a reflection of 5%. Reference to Fig. 3 indicates that an angle of 10° is associated with a gain of 15 and a reflection factor of 10%. Thus, the fabrication formula for the screen is the same as required for a screen gain of 15, but with sufficient black pigment to reduce peak gain to 3.5. The black pigment also resulted in lowering the reflection factor from 10 to 5%.

Effect of Screen Gain on Uniformity

Reference to Fig. 2 indicates that uniform brightness for nominal bend angles is not obtainable even at a screen gain as low as one. Fortunately the eye's sensation to brightness is not linear but is close to a logarithmic response. Brightness differences of two to one will appear to be quite uniform. From practical experience it has been found that most observers do not object to a brightness ratio of three to one. It is not advisable to use a brightness ratio exceeding three to one because the peak gain will be visible as a local bright area. Such localization is called "hot spot" or glare. The hot spot is always on a direct line between the observer and projector and will follow the observer across the screen.

Establishing Maximum Screen Gain

A suggested procedure for establishing maximum screen gain is to prepare a sketch as in Fig. 5, showing the screen, projector and viewing area. A line drawn from the outermost viewing position to the far edge of the projected image defines the maximum bend angle to be satisfied by the screen. The maximum bend angle of the example in Fig. 5 is 57°. A screen satisfying this bend angle may be located from Fig. 3. The 33% gain curve crosses the 57° line opposite a peak gain of 1.0. The 1.0 gain was se-

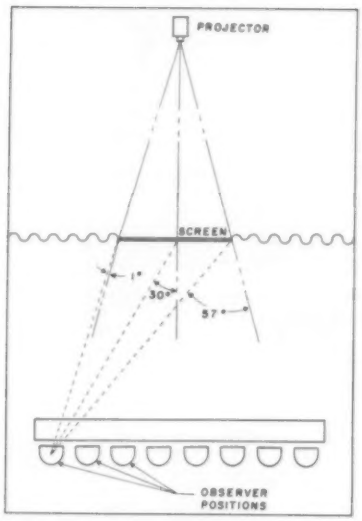


Fig. 5. Projector, screen and critical observer position for obtaining maximum bend angle.

lected from the 33% gain curve indicating that the brightness at the edge of the screen will not be less than one-third the brightness of the brightest area on the screen. Figure 3 also indicates that a 1.0 gain screen will have a reflection factor of 40%. Forty percent of the light from windows or lighting fixtures that falls on the screen will be reflected and reduce the picture contrast.

Rearrangement of the viewing area (and perhaps a longer focal-length lens) to reduce the maximum bend angle to 32° would permit a screen gain of 2.0 as indicated in Fig. 3. It will also be seen that the reflection factor for a 2.0 gain screen is only 20%. The 2.0 gain screen will provide four times as much contrast as the 1.0 gain screen since the picture is twice as bright and the screen is only one-half as reflective to room light.

Screen Selection

The selection of an optimum screen characteristic, as well as the selection of a projector, or of any element of a projection system, cannot be made independently of the system. The selection must coordinate with all the other elements of the system to produce a satisfactory result. It is essential to determine which of the elements are actually fixed; then these factors become the requirements. The remaining factors may then be juggled so as to obtain ultimately an image that is suitably bright and readable.

There are nine factors to be considered and all nine are related to or affected by the others. These are:

1. screen brightness
2. ambient light
3. contrast
4. screen reflection factor
5. screen gain
6. maximum bend angle
7. projection lens focal length
8. picture size
9. projector lumen output

The required screen brightness is about 15 ft-L for motion-picture projection and is limited by flicker to about 20 ft-L. For still projection, a higher brightness may be required to maintain suitable contrast (item 3) because of ambient room light (item 2). The required contrast is either 5 to 1, 25 to 1, or 100 to 1, depending on subject matter. Contrast is the ratio of screen brightness (item 1) to non-image brightness. Non-image brightness is the product of ambient light (item 2) and screen reflection factor (item 4). Screen reflection factor is determined by screen gain (item 5). Screen gain is determined by the maximum bend angle (item 6). Maximum bend angle is determined by the projection angle of the lens (item 7) and the viewing positions and sight line to the far edge of the screen, which in turn is partially determined by picture size (item 8). If all the factors 1 through 8 are known, a suitable projector (item 9) may be selected, the lumen output of which is determined by the formula:

Projector output (lm) =
[Screen brightness (ft-L) ×
Picture size (sq ft)]/Screen gain

Perhaps the most simple and direct approach to selecting an optimum screen, and verifying that a satisfactory image will result, is described as follows:

(1) Establish the required screen brightness. The required brightness for various viewing conditions was discussed under "Human Factors."

(2) Establish the maximum screen gain using Fig. 3.

(3) Establish the desired picture size and also the lumen output rating of the projector being considered.

(4) Solve for screen brightness in the formula

Screen brightness =
(Screen gain × Projector lumen output)/
Sq ft of picture area

(5) Compare the value of screen brightness obtained with the value desired. If the calculated brightness is too low, consider which of three alternatives is least objectionable: reducing the bend angle to permit higher gain, a higher output projector, or a smaller screen area. A fourth alternative is to accept a little less than optimum screen brightness.

Multiple Projection

A three-to-one variation in brightness across the screen is given as a permissible or tolerable nonuniformity. For a single image from a single projector, the change in brightness occurs gradually and is not disturbing. The projection of multiple images placed adjacent to each other introduces a brightness discontinuity at the joining edges. The eye is quite sensitive to brightness differences between adjacent areas that touch. A 5% difference is readily apparent; therefore, a three to one difference may be intolerable.

The perception of brightness differences between two areas is substantially reduced if the areas are slightly separated. A separation representing 10% of the picture width is sufficient to effect a marked reduction in the apparent brightness disparity. It is suggested that the brightness difference between adjacent separated picture edges be limited to two-to-one. Figure 6 illustrates a multiple projector installation drawn to scale. An observing position at which a maximum bend angle will occur (observer *A*) is located within the required observer area. A line is drawn to the center and edge of each projected image to deter-

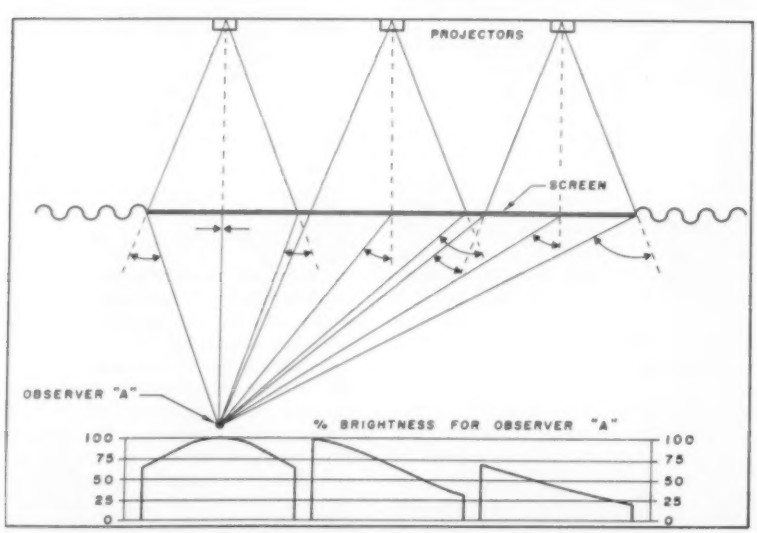


Fig. 6. Bend angles and brightness distribution for multiple projectors.

mine the bend angle for each of these points. Knowing the maximum bend angle, a suitable screen gain may be determined from Fig. 3 using the 50% curve. Brightness distribution of all the images for observer *A* may be plotted as in Fig. 6 from the gain curve of the selected screen. A number of gain curves are shown in Fig. 2. If the selected gain is not represented by one of these curves, it may be drawn in by interpolation with more than adequate accuracy for this purpose.

The Screen Specification

The description "rear projection" avoids confusion with front-projection screens. Picture size is preferred to screen size to designate the clear area within the edge reinforcing tapes. Peak gain, bend angle for 50% gain, and reflection factor are obtained from Fig. 3. A 20% tolerance for peak gain is well within commercial manufacturing tolerances and is adequate for most applications. A bend angle for 50% gain is specified since this number is a critical measure of efficiency. While reflection factor is essentially determined by peak gain and bend angle, its inclusion is desirable for reference and completeness. The reflection factor may vary with the angle of measurement; therefore an angle is specified. The value at 30° generally agrees with the integrated value of total reflectance. The tolerance Notes 1 and 2 are required to establish acceptance limits.

Sample Specification

Screen type	Rear projection
Picture size	5 ft × 7 ft.
Peak gain	2.5 ± 20%
Bend angle for 50% gain	20°
Reflection factor at 30°	16%

NOTES:
1. Bend angle should not be less than 10% of value specified.
2. Reflection factor should not be more than 10% of value specified

Special Screens

All of the preceding discussion, including Figs. 2 and 3, applies to screens in which diffusion is a result of random or statistical distribution of diffusing particles or surface texture. Brightness distribution follows the typical fall-off patterns of Fig. 2. This type of diffusion may be described as a cosine distribution, since the brightness distribution curves can be shown to fit a cosine power function.[5] This type of screen, therefore, has a symmetrical brightness distribution pattern which does not change with a change of screen orientation.

Screens can be made (and a few types are available) in which brightness distribution is nonsymmetrical and not a cosine function. The incorporation of a discrete pattern of very small optical shapes molded into the screen surface produces a much flatter distribution than is indicated by the curves of Fig. 2.

Another type of screen consists of a thin Fresnel lens molded into the rear face of the screen. The function of the Fresnel lens is to change the direction of the principal axis at all points on the screen to intersect at a single point at or near a central observer. The Fresnel lens may be placed behind, but in contact with, a standard diffusing screen. This is a common practice in reflex cameras to provide uniform brightness to the screen corners.

Other screens are of a special nature because they employ black or colored pigments. A wide range of colors is available. For example, a deep cobalt blue seamless rear-projection screen, 40 × 80 ft, is used in motion-picture production for special photographic effects.[6]

When the use of a special screen is indicated, the manufacturer should be consulted for specific details. Even special screens will have a specific gain, bend angle limit, and reflectivity. This data may be compared to the performance curves of Figs. 2 and 3 to determine the relative improvement obtained.

Screens have been made for imaging infrared or ultraviolet. While the instrumentation for measurement changes, the notation for gain and bend angle still applies.

References

1. "Fundamentals of Light and Lighting," General Electric Co. Bulletin LD-2.
2. Armin J. Hill, "Averaging screen illumination readings," *Jour. SMPTE, 67:* 144–148, Mar. 1958.
3. Raymond L. Estes, "Effects of stray light on the quality of projected pictures at variuous levels of screen brightness," *Jour. SMPTE, 61:* 257–272, Aug. 1953.
4. "Foundation for Effective Audio-Visual Projection," Eastman Kodak Pamphlet No. S-3.
5. Armin J. Hill, "A first order theory of diffuse reflecting and transmitting surfaces," *Jour. SMPTE, 61:* 19–23, July 1953.
6. *Ben Hur*, Metro-Goldwyn-Mayer.

A New Approach to Location Recording Techniques

By JACK J. CLINK

Location recording (defined as a recording made with a completely self-contained recording channel that can be moved from one location to the next) is a subject of particular interest to the independent producer. Methods of recording devised to make the best use of presently available magnetic recording channels are discussed. Suggestions are made as to how best to produce material of a consistently high quality for final re-record or transfer.

For over thirty years, location recording has been used in motion-picture production. It has become of equal importance to the independent producer of 16mm documentaries, travelogues and newsreels as it is to the theatrical producer. There is a continuing challenge to improve the techniques of location recording.

The term "location recording" has been subject to various interpretations for a number of years. For the purposes of this discussion location recording may be defined as type of recording made with a completely self-contained recording channel designed to be easily moved from one location to the next regardless of whether one man or many are required. It may receive its power from a local power outlet or from a portable supply using batteries or a generator. The location to which it is moved may be the opposite side of the set or the farthest corner of the world.

In the early days of location recording, when the recording medium was photographic film, considerable care was required to bring home a good negative. Stock costs were high and considerable control had to be exercised to come up with something usable. For the independent producer owning perhaps only one recording channel which was used only a few times a year and operated by a member of the company (who "doubled in brass"), the result was that the recording was sometimes so inconsistent that it detracted from the theme of the film. The producer then would choose the lesser of two evils—post-synchronizing or bridging this spot with narration, either of which is time consuming. For this reason most producers would write sound sequences in a script only when it was an "absolute must."

Bearing in mind these and other adverse factors it would seem that a new approach is indicated. Actually, the "new approach" described here is, like many other "innovations," by no means new. It is, in fact, a back-track from present-day recording trends to less complicated methods of recording for the purpose of allowing more time for the creative aspects of the endeavor. Using this approach, the producer may be encouraged to use more sound in his shooting, even if it is only the rustle of leaves and the accompanying sounds of nature, or at the other extreme, the close-up of a rivet gun in a boiler factory. Increased liaison between the location recording crew and the independent sound service studio results in the location sound man being relieved of many transmission problems, allows him more time for creative work as well as for coping with the untold number of uncontrolled conditions that can arise, either on the set or out-of-doors.

Presented on May 6, 1959, at the Society's Convention in Miami Beach by Jack J. Clink, Byron Motion Pictures, Inc., 1226 Wisconsin Ave., N.W., Washington 7, D.C.
(This paper was received on April 27, 1960.)

Magnetic Tape

Magnetic film or tape recording is easier to comprehend if "magnetic" is thought of as a holding medium, whereby a mythical transmission line from the portable mixer, through the cutting room, ends at the re-recording console where it is finally equalized, or compressed, or whatever the case may be, and then laid down on the negative. Where this line of demarcation will be might be influenced by the following thoughts.

Having been associated with the sound service studio phases these past few years has presented an opportunity to observe, first hand, some of the problems confronting the producer, particularly if he operates on a limited budget, and does his own recording with a minimum of technical staff and equipment.

The first consideration is, logically, where and how the sound originates. The question is what to do so that when the sound comes to the microphone nothing will have occurred to detract from the intended effect. Microphones, while they differ from the human ear in appearance, also differ just as drastically in their ability to pick up sound. The human hearing system has that "certain something" which enables it to concentrate on the wanted sounds, and, more or less, exclude those not wanted, except in the rare case of extremely high-level unwanted sound. Unfortunately in the case of the microphone, the sound of noisy lamps and off-stage noise is apparently as pleasing to it as a pleasant voice, so care must be taken to lessen its chances of hearing anything unwanted. The rule, therefore, when recording in places where the sets or locations were not chosen with sound foremost in mind, is to keep off-stage noises down to a minimum, and to cover the floors and walls, if necessary, with pads or felt to minimize echo as well as noise. The microphone, if the mechanics of a scene will allow it, should be kept away from noisy lamps or other pieces of equipment that could give trouble.

Most important of all is an alert soundman who tries to anticipate these problems and make the corrections before the directors says "Roll!" Once the set is lit and shooting is to commence, it is too late to start redoing the set to better the sound. The stock answer from the director, and he is correct in giving it, is, "Time is getting on and we will have to make the best of it." It should be added at this point that it is "penny-wise and pound-foolish" to choose an inferior monitor system. If earphones are used, they should be of very good quality, with an extreme dynamic range. At the final re-recording session a frequent comment is often heard: "That's odd, I don't remember hearing that when it was shot." The re-recording console is too late in this mythical line to take out off-stage noise that covers an important word or phrase.

Any hi-fi fan will at some time be "carried away" by recordings on magnetic tape that go to both ends of the audio spectrum, particularly on the high end. Presence in the original is a very desirable thing, but quite often one runs across tracks for transfer or for re-recording purposes that give us endless trouble due to the over-emphasis of presence, and even with various equalizers, good control in the optical phase, a very high degree of sibilant distortion is present, resulting in an unacceptable job.

The Release Print

With reference to wide-range recording on magnetic tape a release print on optical, particularly 16mm, the usable range is very limited. The range on most 16mm projectors is pretty much limited to the neighborhood of around 6000 cycles. The result is that if a negative is made extending out to the neighborhood of 8000 or 10,000 cycles, it is quite

obvious that this is lost in the final release. Consequently, all this wide range only goes as far as the monitor system in the re-recording theater. What then is the answer to getting a good release print? The thing to bear in mind is the available usable range of the equipment it will finally be projected on so that full advantage may be taken of this area.

For example, good-quality motion-picture recording microphones are directional to the high frequencies, and this can be turned into an advantage. If the voice being recorded is too sibilant, then the obvious thing to do is to change the microphone placement to minimize this high effect. When a track reaches the re-recording console with this sibilant condition, the solution is to use a sufficient low-pass filter to cut off the top end. While this would seem to correct the problem, it is remindful of the proverbial ostrich who puts his head in the sand when danger is around, hoping that all is well. As a matter of fact, all is not well. What has happened is that not only has the high end been taken off the voice but also off of everything else concerned with that particular take, so that the end result is that this take does not match the quality of anything else, thus creating difficulties in inter-cutting. Had a little thought been used originally, and maybe the microphone placed a bit differently, the end result would have been a good, instead of a barely acceptable recording.

After reading these statements, hi-fi fans may engage in mental arithmetic while wondering how in the world with only a 6000-cycle range on the top end it is possible to get good quality with plenty of presence. So, it should be explained that by emphasizing or raising the mid-high range, which is in the neighborhood of 3500 cycles, it is possible to bring up the presence and still stay below the cut-off.

A number of changes have been made in the past few years. Optical recorders have been developed to a point not dreamed possible a few short years ago, in both mechanical and transmission characteristics. Spray developing machines and better printers contribute very definitely to achieving release quality that nearly approaches the original magnetic quality.

Too often overlooked in some types of pictures, but nevertheless important to all types, is that the purpose of a picture is to create an illusion, whether it is that of being stranded on a lonely atoll with nothing but thoughts of home, or of looking inside an anthill in darkest Africa. To help the director of a film realize this, care must be taken that recordings from take to take, as well as from day to day, be consistent. One of the many ways to achieve this is to have a pair of matched microphones with good characteristics. No more than one microphone should be used at a time, unless physical problems make it impossible to cover everything with one. The camera has only one point of view, so the same illusion or perspective should be maintained in respect to sound. It should be noted that these remarks are related to monaural recording.

Equalizers are a good feature to have in a recording channel; but they should be used with caution. Once the recording curve has been altered by their use, you have to live with it. It has been the author's experience that there is more latitude if the recording is done flat, leaving the equalizing to the service studio which normally has a wider array of equipment available, as well as controlled monitor condition. It should be noted that equalizers do not add certain desired frequencies, but instead subtract others. In other words, if a boost is needed in the mid-highs, an equalizer lowers the rest of the audio spectrum, leaving the mid-highs where they were. Then the overall level is brought back up. In the background lies that lurking problem of signal-to-noise ready to take over. Therefore, it is recommended that equalization be left to the sound service studio.

Pursuing this problem of consistent sound recording, earlier mention was made of characteristics of microphones, including their inability to distinguish between certain sounds. While this is a bad feature, it can be controlled and used to advantage, because if only those wanted sounds were recorded and unwanted sound completely excluded, the recording would become dull and lifeless. It would sound as if it were done in a soundproof chamber. Therefore, a certain amount of background sound is desirable, and while it is not noticed if it is the right level, its sudden absence or complete change in the middle of a scene would be just as jarring as any other off-stage noise. Therefore, the thing to bear in mind when shooting from scene to scene, as well as from day to day, is that the background sounds relating to any particular sequence should be as near the same as possible. It is realized that in most industrial films certain conditions cannot be controlled, so it is desirable that, at the first break allowed during shooting, a background track be made of the surrounding sounds which can later be used as a loop or a straight roll of sound effects to carry the illusion all the way through.

A fairly good signal to the recorder is of little value unless it can be laid down properly on whatever recording medium is to be used, preferably magnetic, and unless it can be reproduced at a future date with as good fidelity as the original sound.

There has long been a controversy as to what magnetic medium is best suited for motion-picture sound recording. In the early days of magnetic recording on film, the best medium was 35mm or 17½mm film, but stock costs and the bulk of this film were disadvantages. Later ¼-in. tape became quite popular and with a pulse sync was a good substitute for the 35mm film. At present, manufacturing tolerances have advanced to such a point, both in the mechanical end as well as in recording heads, that it is now possible to record on 16mm magnetic with a recording characteristic which closely approximates 35mm film or ¼-in. tape, with the added advantage that recording stock costs have been reduced and the currently used sprocketed film enables the producer to edit original material, thus eliminating one generation caused by transfer.

There are many good recording channels on the market today. In the author's opinion, the best criterion for judging overall performance is usually a reliable manufacturer, and good equipment is expensive; but the performance of even the best depends largely on its maintenance. Perhaps the biggest problem the service studio has with tracks turned over to it for transfer is misalignment of the recording head. This results in a soundtrack with the whole top end shaded off, and a high degree of misalignment can bring this shading down to a spot where what was originally a crisp sound is reproduced as a mumble. While it may be possible to bring this sound up to a fairly intelligible track by the use of various equalizers, again the problem of signal-to-noise plays an important part, in regard to the sound, the original fidelity of which was lost in misalignment. The end product will probably be a track that has such a high hiss level and background noise that it is practically useless. The SMPTE has available numerous magnetic azimuth alignment films which should be tools for anyone having one or more pieces of recording equipment. Upon receipt of these films, the head will not align itself if the film is left sitting in the can week in and week out. Periodic checks using appropriate test film, should be made very frequently.

Head Wear

In magnetic recording the recording medium is basically a very fine abrasive, so it is quite natural that the heads will start to show wear after a certain period of time. When heads are worn too badly, the gap increases, with the result that the high end again falls off the track. When this happens, the heads should be replaced with new ones. It is assumed that in the electronic end of the recording channel frequent checks are being made to determine whether the noise problem is increasing, distortion

is down, and the proper amount of recording bias is applied to recording heads. Wrong head bias can introduce distortion and noise.

Source of Power

Another important consideration in location recording is the source of power when local power is not available and it is necessary to use a portable power supply to drive both camera and recorder at a synchronous speed. Very satisfactory results have been gained by the use of a rotary converter driven by wet batteries. Since weight is an important factor in location travel, power units should be cut to a minimum, both in weight and bulk. A good rotary converter which will drive the average recorder (assuming it does not have torque motor take-ups) and one or two cameras would probably weigh about fifty-seven pounds, and be driven by 24 or 32 volts of wet batteries. It is sometimes more desirable to purchase or rent these near the location. In almost any corner of the world automobile batteries are available. Getting batteries locally eliminates the nuisance of shipping them. It is a must that a common source of power be used for all pieces of equipment so that any change in voltage or frequency be common to all pieces of equipment whether cameras or recorders.

To summarize briefly, the use of a little common sense together with a better understanding of the limitations imposed on both the location sound crew and the sound service organization will enable the producer to come much closer to realizing what the script originally called for.

Controlling External Noises for Recording Studios

By DONALD P. LOYE

Quite recently, oil wells have been drilled on studio properties, creating new noise and vibration problems. Solutions to these problems include the suitable location of each drilling site relative to studio activities; acoustical insulation of drilling derricks and associated machinery, and the mounting of machinery on vibration isolation mountings. These, as well as other noise and vibration problems involving freeways, airplanes and electric power stations, are described in this paper.

DURING THE EARLY days of motion pictures, sound was neither an asset nor a liability. Neither the actors' voices nor airplane and freeway noises had become factors to be reckoned with in the production of motion pictures.

About 1927, sound was added to motion pictures. From then on, the director had to give up the use of a megaphone to cue and direct actors. Music could no longer be played near the sets to soothe the actors. Cameras could not be operated in the open near the actors and microphones because of the noise they made. Quiet cameras in sound-proofed housings were required. The old "silent" stages were no longer satisfactory — they had to be made silent in reality.

Furthermore, the old stages were barn-like and reverberant. Speech could not be recorded properly in such stages. They had to be acoustically treated as is standard practice today. These are only a few of the many sound problems encountered in the recording of sound motion pictures.

Disney Studios

One of the motion-picture studios built from the ground up for optimum sound recordings was Disney. They took advantage of experience accumulated in converting silent motion-picture studios to sound in their noise insulations and interior acoustical designs. Their site was not decided upon until a carefully conducted noise survey had been made.

Noise measurements were made over a period of time to obtain an idea of what noises the scoring, production and dubbing stages, theater, review rooms, offices and other facilities would be subjected to. Calculations were also made to determine future noise conditions. The survey indicated that traffic noises were less disturbing than expected, but that airplane noises were more of a problem than anticipated.

The result was that wall structures were simplified to provide less but adequate acoustical insulation, and the roofs of the stages in particular were strengthened to provide greater insulation. These changes saved thousands of dollars and provided studio facilities more suitable for the exclusion of the outside noises.

Goldwyn Studios

The population of Southern California has been growing rapidly for many years. Electrical power supplies have been expanded to take care of this growth as well as the increased use of electrical appliances, particularly in the home.

One such expansion made it necessary to build a transformer power station on the back lot of Goldwyn Studios (Fig. 1). Barriers were built around the transformers as a noise shield to protect the sensitive sound motion-picture recording facilities of the studios.

Another important step was taken to prevent noise disturbance to the studios. Power transformers designed to have a low noise level were specified for use. As a result, the transformer station and the studio sound recording facilities operate together without interference.

Freeway Construction

Another result of the rapid population growth has been increased freeway construction. In the summer of 1954 a noise survey was called for by the California State Highway authorities to determine the most satisfactory freeway routing through the San Fernando Valley. Four major motion-picture, radio and television studios were involved, in different ways, by the four principal routings being considered.

The stages, outdoor sets and other facilities were subject to varying noise interferences, depending upon the routings. For instance, some outdoor sets would have become too noisy for most uses had the freeway been routed closest to one studio. A large stage at another studio had sufficient acoustical insulation for the existing noise conditions but would have been inadequately insulated against freeway noises.

Figure 2 is an aerial view of NBC radio and television studios as they were several years ago. Since the studios are located close to main thoroughfares, stages had to be constructed to reduce this noise for recording purposes. Warner Brothers

Presented on May 2, 1960, at the Society's Convention in Los Angeles by Donald P. Loye, Consulting Engineer, 10578 Holman Ave., Los Angeles 24.
(This paper was first received on April 16, 1960 and in final form on December 20, 1960.)

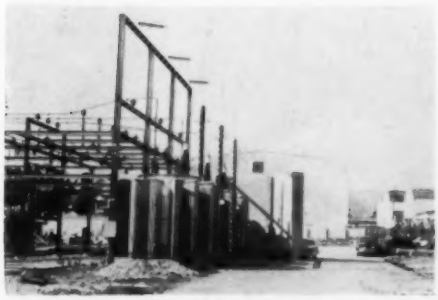


Fig. 1. Transformer station and portion of Samuel Goldwyn lot, Hollywood, Calif.

Fig. 2. Aerial view of NBC Studios and surrounding traffic highways, Burbank, Calif.

Studios are nearby, just below the range of this picture. One of the freeway routings considered was between these two studios. Similar problems were involved in routing the freeways around Universal and Republic Studios.

Oil Well Drilling

Within the last few years, oil has been discovered on motion-picture studio properties.* It has therefore become necessary to guard against the noise of drilling operations. This has been successfully done by careful planning, by the acoustical insulation of derricks and associated equipment, and by carefully controlling drilling operations.

Twentieth Century-Fox Studios

One of the studios where oil was suspected was Twentieth Century-Fox. Plans were actively begun nearly ten years ago to apply for a drilling permit and make arrangements to control the noise to the satisfaction of all concerned. The Twentieth Century-Fox lot location selected as most promising for oil was on Olympic Boulevard near the Beverly Hills High School grounds. This being one of the first wells of recent times proposed to the West Los Angeles-Beverly Hills area, there was considerable opposition to granting the drilling permit.

One of the first steps taken by the Universal Consolidated Oil Co. before applying for the permit was to study the conditions in the La Habra Heights area where drilling in residential and country club locations had been successfully carried on by that company and by Union Oil Co. in particular. The drilling operations in the La Habra Heights area bear no resemblance whatsoever to the development of the Signal Hill oil field during the early 1900's.

In order to show the advantages of modern, carefully planned, acoustically silenced slant drilling methods, a sound motion picture was made of neighborhood drilling operations. It demonstrated what can be done by care in arranging and locating the drilling equipment and covering the derrick and associated machinery with a sound insulating enclosure. Furthermore, noise can be controlled by careful operation of the equipment.

The results of drilling operations at Location 1 near Olympic Blvd., where eighteen wells have been completed, have been gratifying. Practically no complaints have been made by the neighbors, nor have the operations interfered with studio recordings. At one time in planning for shooting on a nearby outdoor set, it was noted that the chain drive of the drilling rig was producing more than the usual noise. Adjustments were made which restored the operations to normal and avoided interference with the motion-picture shooting program.

Figure 3 illustrates the relation between the derrick of Location 2 and the nearby set. The set in the foreground is about 300 ft from the derrick.

Paramount Studios

Figure 4 shows a drilling site on the Paramount Lot shortly before the derrick with its acoustically insulated enclosure had been erected. The picture was taken from the roof of the Mechanical Building, behind which are sound stages. Precision mechanical work done there would have been interfered with if oil well machinery had produced excessive vibration. Instruments were set up by the Union Oil Co. to check the operation of oil well machinery for vibration disturbances.

Because of the nearness to the residences and studio facilities, and due to the quietness of the neighborhood during the night and early morning hours, extra precautions were taken to avoid excessive noise.

Fig. 3. Twentieth Century-Fox Studios oil well derrick and nearby motion-picture sets, West Los Angeles, Calif.

* Additional information regarding noise controlled oil well drilling in residential areas has been described in an article by the author entitled "Oil Wells Make Good Neighbors," *Noise Control, 4:* 3; p. 26, May 1958.

Fig. 4. Paramount Studios lot drillsite during preparation for the erection of the sound-proofed derrick.

Fig. 5. Inside the Paramount Studios sound-proofed derrick looking toward the top.

The interior of the acoustically treated derrick, looking toward the top, can be seen in Fig. 5. It should be noted that there are no cracks evident in the acoustic insulation. A portion of the top of the derrick is open for ventilation purposes. However, noise measurements made from bottom to top of derricks indicate that the noise level at the top is substantially lower than at the bottom where the machinery is located. Around the lower portion of the derrick enclosure there is an extra interior layer of acoustical treatment for additional absorption and insulation.

As a result of the care taken, there was no interference with studio production schedules due to oil-well drilling activities. Vibration and noise were also controlled to some extent by adjusting the weight on the drill and also its rotational speed.

MGM Studios

Figure 6 shows the Continental Oil Co. derrick on the MGM Lot. Stages 29 and 30 are a little more than 300 ft away. Furthermore, the Matt Painting Building, which has rigid vibration requirements, is located about the same distance from the derrick. Studio authorities were concerned about both the noise and vibration to be expected from the oil well machinery.

In order to determine whether there would be interference between drilling operations and motion-picture shooting, maximum permissible noise limits were set by the studio for it stages. A test was then made of the noise transmitted into the stage nearest to the derrick. The measurements proved that the stage insulation adequately kept the drilling noises within the stage well below the specified levels.

Tests were also conducted to determine the vibration effects to be expected upon the Matt Painting facilities. For cooperation in these tests, the Union Oil Company loaned one of its most capable engineers, one experienced in measuring such drilling vibrations and their effects upon studio facilities.

A pneumatic pavement chipper was used at various distances from the Matt Painting Shop facilities to simulate the effects of the drilling machinery. The results indicated that no interfering vibrational effects were to be expected from the drilling machinery operations.

Fig. 6. The MGM Studios sound-proofed derrick with stages in the background.

This is the history up to the present of another set of heavy machinery that has invaded the studios but through careful planning and control has been prevented from interfering with studio motion-picture production activities. In most cases so far, this invasion has proved its worth by discoveries of oil which have added to studio incomes.

Conclusions

Although motion-picture studios are faced with protecting themselves from outside disturbances, all noise problems can be successfully solved through careful scientific planning. This was proven by Disney in overcoming traffic and airplane noises. It was true in providing against power transformer noise interfering with motion-picture production on the Goldwyn lot.

Freeway traffic threatened to interfere seriously with recordings on four of the major studio lots in the San Fernando Valley. This was reduced to a minimum by a survey of conditions existing prior to the freeways, as well as calculations of noise conditions to be expected from the four alternative main routings.

The oil well noise and vibration problems have affected three studios at present, and others undoubtedly will be affected in the future. Careful study and planning have made it possible for motion pictures to be made within 300 ft of oil well drilling.

All noises that have been experienced have been conquered by careful scientific planning. This leads to the conclusion that similar careful planning in the future will make it possible for sound motion-picture production to be carried on under noise conditions that have not yet appeared.

The Control of High Power Xenon Flashes by Magnetic Switching

By E. J. G. BEESON

The xenon-arc discharge is very susceptible to a magnetic field and the arc can be deflected to extinction. In this way a lamp can fulfill a dual purpose, by emitting light radiation while functioning as its own circuit breaker. Investigations have centered around a 2-kw design of a compact-source xenon lamp with increasing gas pressures and with lamp currents of up to 1000 amp. By the use of a magnetic field to extinguish the arc and thereby break the lamp current, substantially square-wave pulses of light are obtained in the region of 10 to 100 msec. With these high lamp currents the lead-acid battery provides a satisfactory source of power and with light flashes of up to 50 kw the arc characteristics and the light efficiency output have been studied. Comparisons are also made with earlier discharge lamp designs which are of particular interest for high-speed photography.

Magnetic arc switching is already being used successfully as a means of providing an occulting light in the Dungeness Lighthouse. Higher flash powers are switched with shorter durations enabling higher-speed camera operation and entering a field where rotating mirror cameras demand still higher light intensities.

THE XENON-ARC discharge is very susceptible to a magnetic field and its arc can be deflected to extinction. Because of this, a lamp can fulfill the dual purpose of emitting light radiation and breaking its own circuit.

So far, prolonged flashes of light from discharge lamps have been generated by superimposing a momentary increase in power onto the steady lamp current. This produces light flashes of constant intensity for durations extending from 1 to 3 sec. High speed contactors have provided a simple means of controlling current during the flash period. For shorter duration flashes in the region of 1 to 3 msec artificial line networks have been used to control current and provide a substantially constant intensity.[1,2]

The method of switching high lamp currents by using a magnetic field to cause arc extinction provides a simpler and more accurate control when generating light flashes in the region of 10 msec to 100 msec. Thus, we are no longer dependent upon an electro-mechanical relay with its inherent limitations of time variation and contact resistance problems. Further, where a short arc gap lamp is required for optical reasons, the discharge lamp impedance falls to a very low value compared with a xenon flash tube. As a result, it becomes difficult to match with a capacitor/inductor pulse-forming network to control the lamp current.

Various methods have been used to generate substantially square-wave light pulses of high intensity. Following consideration of these, characteristics of the xenon-arc discharge at currents of 500 to 1000 amp for periods of 10 to 100 msec are examined in detail. Particularly noted will be currents of this order that are switched by using magnetic forces to cause arc extinction. With these higher currents, it is also necessary to consider the source of electrical power.

Equipment, using mercury, and later, xenon lamps of the compact source type has been developed to meet the special lighting problems of high-speed photography, particularly for cameras of the optically compensated image type. Magnetic arc switching extends the peak current that passes through the discharge lamp, to provide much higher light intensities for nonluminous objects, thus permitting higher speed camera operation and entering the field where rotating mirror cameras depend upon still higher light intensities.

Presented on October 17, 1960, at the Fifth International Congress on High-Speed Photography in Washington, D.C., by E. J. G. Beeson, Associated Electrical Industries Lamp and Lighting Co. Ltd., Melton Rd., Leicester, England.

Present Methods of Generating Pulses of Light

Discharge lamps have a high degree of efficiency for converting electrical energy into visible light. In comparison with other light sources, they will withstand an appreciable overload without failure. This suggests that the power in a discharge lamp may be increased for a predetermined period of time in order to generate a flash of high intensity.

Depending upon the current increase and its duration, a failure point is eventually reached in a lamp. Usually this is due to the destruction of an electrode or one of the lamp seals. Within the failure limit, however, practical lamp designs have emerged which achieve at least a tenfold increase in light output.

One of the first lamps designed specifically for high-speed cinematography operation between 250 and 3000 frames/sec was the 1–10-kw Type MEC/U lamp.[3] This is a lamp of the compact source type containing mercury and cadmium. Under normal steady burning conditions, a vapor pressure of about 15 atm is reached to give characteristic high pressure mercury radiation. Color improvement from a cadmium inclusion gives a luminous efficiency of 45 lm/w. The lamp operates from direct current, is natural air cooled and continuously dissipates 1000 w. When the lamp is flashed, powers of 10,000 w for 1 sec, 5000 w for 2 sec or 3000 w for 5 sec are dissipated.

The arc voltage of 60 to 75 v permits lamp operation from a 110-v d-c supply. But, since it is desirable to have at least two sources for light modeling, the equipment operates two lamps in series from a 200 to 250-v d-c supply. Figure 1 shows a large installation over a water tank where 10 lamps provide over 3.6 million lm with a flash power of 100 kw for 1 sec.

The lamps are started by a voltage pulse and about 10 minutes elapse before full light output is reached. Once the lamps have reached full brilliance, a micro-switch closes a high speed contactor which short circuits most of the series ballast resistance to increase the lamp current to the required level. A timing circuit controls the duration

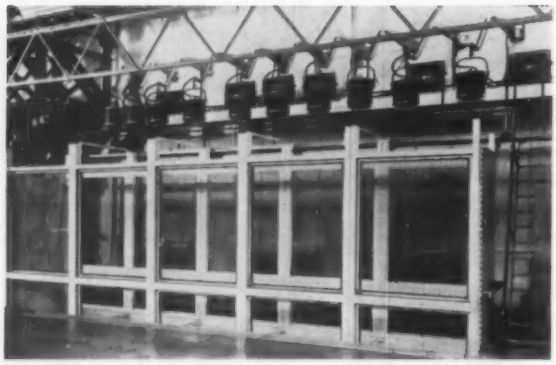


Fig. 1. A 100-kw pulsed mercury lamp installation.

of the flash and a single switch selects the flash power and its duration. A time delay is incorporated to prevent flash repetition within 15 sec as the mean power dissipation of the lamp is limited to about 1200 w. When a high-speed shot is taken in color, an initial flash is given, followed closely by the actual flash. The latter instills a higher proportion of cadmium to give a much improved red content.

The maximum flash power in this type of lamp is limited by anode fusion. An increase in the peak power with a shorter duration flash is possible. However, it becomes increasingly difficult to design a simple circuit breaker that controls a shorter flash with precision while carrying and breaking higher currents at a voltage of 250-v d-c.

A compact source xenon lamp, such as a 2-kw Type XE/D/23, has some advantages over the mercury lamps when operated in a similar way.[4] Perhaps the most important is a low arc voltage characteristic which permits lamp operation from a low voltage battery supply. A xenon lamp may therefore be operated on location, and, even under flash operation, is not limited by the current taken from a rectifier or supply mains. The lamp gives instantaneous light output and emits radiation of excellent color, but its light efficiency is lower, being about 0.7 of the efficiency of a mercury-cadmium lamp.

The design of compact source xenon lamps closely follows that of the high-brightness mercury sources and their basic designs are well known. The use of these lamps is increasing in cinema film projection as well as in other optical applications.[5] A typical 2-kw Type XE/D xenon lamp is shown in Fig. 2.

Equipment has been developed to operate the xenon lamp in a way similar to the 1–10-kw MEC/D lamp. The xenon lamp, however, operates from batteries. The xenon flash equipment is shown in Fig. 3. Although the lamp is designed as a natural air cooled unit which dissipates 2-kw continously, the power is reduced to a nominal 750 w to conserve the batteries. This power still provides more than adequate illumination for modeling and lens focusing. The control equipment operation resembles that of the mercury lamp flash unit. A single selector switch permits flash powers of 7500 w for 1 sec, 5000 w for 5 sec or 3000 w for 10 sec.

Heavy duty lead acid batteries provide 36 to 42 v for lamp operation. The batteries must have at least a 100 amp/hr capacity. Although currents up to 250 amp are taken by the xenon lamp to give 7500-w flash power, the contactor short circuiting the ballast resistance is not required to break a very high voltage.

The lamp can be started instantaneously by applying a voltage pulse of about 10 to 15 kv across the probe and cathode. The high voltage is generated by a booster coil energized from a battery tap at 28 v. It is then rectified to charge a capacitor. The energy, in turn, is discharged into a pulse coil through a controlling hydrogen spark gap. This superimposes a transient high voltage pulse onto the steady voltage which is applied to the lamp probe to ignite the probe arc. Once the auxiliary arc has started, ionization instantly ignites the main arc.

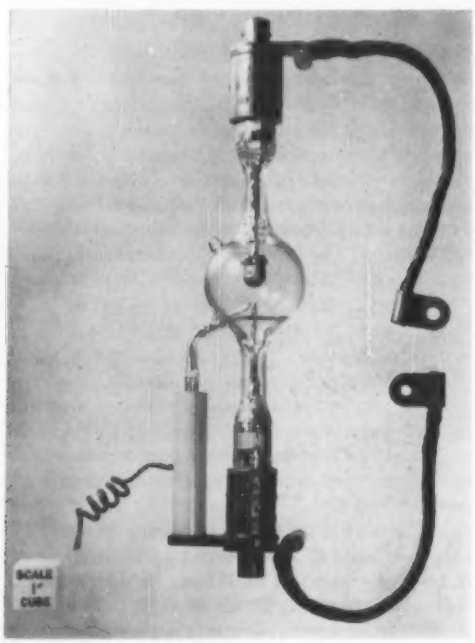


Fig. 2. The 2-kw xenon lamp.

Fig. 3. Xenon Cine Flash Unit using the 2-kw xenon lamp.

Pulsed 2-kw Xenon Lamp Characteristics

The xenon arc has a positive characteristic with increasing current. Conversely a battery has a falling voltage as the battery load is increased. For normal battery operation at 28 v d-c, the 2-kw xenon lamp has a cold xenon pressure of 2 atm and a nominal arc voltage of 23 v with a current of about 90 amp. A luminous efficiency of 30 lm/w is then achieved which emits about 3.0 candle a/w. The arc gap of 8.5mm provides for stable arc operation when the lamp is horizontal or vertical (the probe being always in the lowermost position). This combines with a maximum arc voltage, in relation to electrode losses, to give an optimum high light efficiency for a compact source lamp.

It was noted above that when the lamp is used in a Cine Flash Unit, it is operated at a reduced power to conserve the battery. This also reduces the anode temperature and increases the thermal capacity so it can support a current of 260 amp for 1 sec,—an equivalent flash power of 7500 w. If the anode had been supporting its normal current of 90 amp continuously, the maximum flash current for 1 sec would be reduced to about 190 amp, or a flash power of about 5000 w. Were a continuously burning lamp overloaded, the anode would begin to fuse with a sustained current of 150 to 170 amp and would rapidly blacken the lamp envelope.

The efficiency of light generation in a xenon arc is dependent upon current density and gas pressure. A lamp flashed from cold to 7500 w gives a candle power output of about 2.5 cd/w. When operating steadily at 2 kw the lamp gives 3 cd/w and the gas pressure increases by a factor of $2\frac{1}{2}$. There is some efficiency gain if the lamp is flashed after simmering at a power of 750 w.

Experiments have shown that the MR.456 Compact Source Xenon Pulse Light equipment, with a 2-kw XE/D/23 light source, the lamp focused to full spot, and flashed at the full setting, permits high-speed photography camera operation as follows:

(a) Using high-speed panchromatic film ASA160, perfectly exposed negatives of a medium toned 12 in. wide subject are obtained at 16,000 pictures/sec with a lens aperture of $f/8$.

(b) With daylight color film ASA8, an aperture of $f/2.7$ and a speed of 16,000 pictures/sec give excellent color rendering of a medium toned subject 6 in. in diameter.

While the xenon arc has a high energy output in the near infra red, the longer wave radiation, or heat from the lamp, is such that no discomfort is felt on the human face when the lamp is brought to a maximum spot at a distance of 3 ft and flashed at $7\frac{1}{2}$ kw.

The average life of the xenon lamp is about 1000 hr when operated continously at 2-kw. Although the life of the lamp under flash operation depends upon the flash power, many thousands of flashes are obtained.

Magnetic Switching of Xenon Arc

A limit has been reached in the maximum power at which the 2-kw xenon lamp may be flashed for a duration of 1 sec. By flashing from cold, higher lamp currents can be supported by the anode. Breaking control at higher currents and shorter flash durations is obtained by magnetic switching of the arc discharge to extinction.[6,7]

Arc discharges in a chorded or compact form are susceptible to a magnetic field since the arc itself is a conductor with a magnetic field generated around it. Since the inception of discharge lamps, magnetic fields have been used to deflect and control the arc and to overcome the tendency for it to rise due to convection currents. This is particularly true with long light sources where the arc is wall stabilized and the lamp operates in a horizontal position. Without this correction, the arc causes the arc tube to overheat and ultimately fail through softening or cracking.

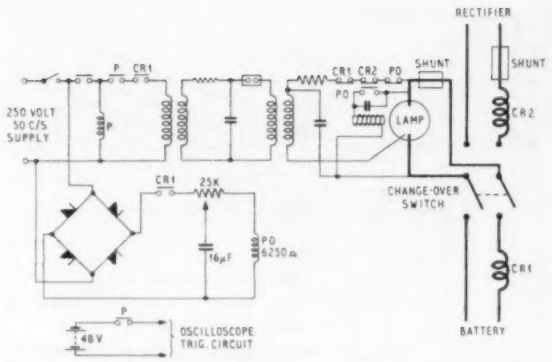


Fig. 4. Circuit for controlling xenon flashes by magnetic switching.

In order to extinguish an arc by means of a magnetic field, it must be deflected to give elongation, and arc voltage must be increased until it exceeds or approaches the supply voltage. The xenon arc is very sensitive to even a weak magnetic field, and, providing the supply voltage does not exceed the lamp voltage by more than a factor of about 2 or 3, the lamp can function as its own circuit breaker.

The time taken to extinguish the arc depends upon the rise time of the magnetic flux. Some persistence of the flux is necessary to prevent arc re-establishment since the deionization period of the excited xenon atoms, the thermal state of the lamp and cathode condition promote arc reignition. These parameters have not been examined in great detail. A simple cylindrical coil of 30 ohms resistance with an iron core of 1 sq in. and energized at the lamp arc voltage, has been used. The magnetic circuit has a current rise time of about 15 msec which is acceptable where 100 msec flashes are considered. Where shorter flashes are required, the magnetic time constant must be reduced, since magnetic flux must not build up during the ignition period when the arc is most sensitive to the influence of a magnetic field. Use of a low-inductance coil has shown that flash durations of 10 msec are possible. However, there is a departure from a square-wave light flash since some magnetic flux build-up immediately follows the arc ignition cycle. The rise time of the light flux on arc ignition is almost instantaneous.

The impulse starting circuit (Fig. 4) shows the use of an auxiliary probe for arc ignition. This permits the dissipated power to be controlled by the number of batteries or cells used. The total impedance includes the internal resistance of the battery and, the small resistance of the heavy connecting lamp leads.

At low supply voltages, arc ignition is possible only by using an auxiliary probe. Where precise timing of a short duration flash is required, a minimum supply of 70 v or a voltage doubler circuit may be used by applying the starting pulse voltage across the main lamp electrodes. A

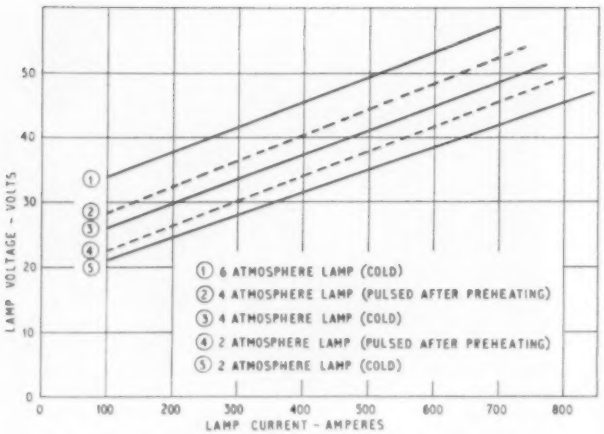

LAMP VOLTAGE - VOLTS
LAMP CURRENT - AMPERES
① 6 ATMOSPHERE LAMP (COLD)
② 4 ATMOSPHERE LAMP (PULSED AFTER PREHEATING)
③ 4 ATMOSPHERE LAMP (COLD)
④ 2 ATMOSPHERE LAMP (PULSED AFTER PREHEATING)
⑤ 2 ATMOSPHERE LAMP (COLD)

Fig. 5. Volt-ampere characteristics of pulsed 2-kw xenon lamp.

high-frequency choke in series with the lamp is necessary to impress a high voltage pulse across the lamp electrodes. It is generally of low inductance, (approximately 50 mh) so that this has little effect on the current rise time. Test results have shown that there is a drift of less than 10 msec when the arc is initiated by the probe circuit.

Lamp Characteristics With Magnetic Switching

To obtain electrical and light output parameters of the 2-kw xenon lamp as current is increased, the circuit is timed to give light flashes lasting approximately 100 msec. Figure 5 shows the volt-ampere characteristics of the lamp with a normal arc gap of 8.5mm and cold xenon filled pressures of 2, 4 and 6 atm. Lamps with 2 and 4 atm xenon pressure are also flashed hot, i.e., running at 2-kw for 1 minute, then allowing anode cooling for 1 minute prior to flashing.

In all instances there is a marked linear increase in the arc voltage with increased current. Similarly, there is an increase in arc voltage with increased gas pressure. This is also true when the lamp is flashed hot. With an eight-fold increase in lamp current, the arc voltage is doubled.

Figure 6 shows a steady increase in the efficiency of light emission with high current density in the pressure constricted arc discharge. During normal continuous lamp operation where the quartz bulb reaches an average temperature of 600 to 700 C, the gas pressure is increased 2.5 to 3 times. Under flash operation, however, there is an instantaneous increase in gas pressure. No assessment has been made of this increase; but the power dissipation is increased some 20 times compared with that of normal lamp operation at 2-kw.

At low flash powers, light efficiency is lower than that of a lamp operating continuously at 2 kw and an increase in gas pressure contributes to a higher current density in the arc discharge. However, as the current in the flash is increased, the cd/w exceeds that of a lamp operating steadily at 2-kw. Photographic technique can benefit from a flash of light that is not superimposed on a lower level of continuous illumination. A further increase in light efficiency is obtained if a lamp is hot flashed as described above, after its gas pressure has been increased by operating the lamp at its normal power of 2 kw for a period of 1 min, switching it off and allowing the anode temperature to fall for 1 min and then flashing the lamp. For a similar flash power the pressure gain is 0.5 to 0.6 cd/w.

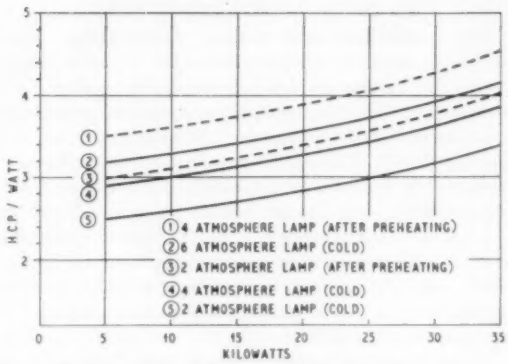


Fig. 6. Light output from pulsed 2-kw xenon lamp.

Most of the tests made with flash durations of 100 msec and lamp currents up to 800 amp have produced little anode fusion. This indicates that flashes of longer duration are possible. With a current level of 650 amp in a 4 atm lamp, anode fusion takes place after 450 msec when the lamp is cold flashed. It is interesting to note that the tungsten anode is able to withstand these severe thermal shocks. The anode tip is raised from cold to melting point within a few hundred msecs and the whole anode block reaches a thermal equilibrium of 500 to 600 C after 2 to 3 sec.

Battery Characteristics and Light Waveform

The light waveform of a lamp under flash operation will depend upon the volt-ampere characteristic and the voltage regulation of the power supply. Power supply requirements are met by the use of a suitable battery. While each type of battery has certain desirable characteristics, the lead-acid type is best for our purpose in terms of size, weight, life, maintenance and cost.

The silver-zinc cell with a 60 amp/hr capacity, weighing about 70 lb will give a 1000-amp discharge for the flash durations considered. Although it is a light, compact unit, its high cost precludes its use other than for some very specific purposes.

Nickel, iron or cadmium cells have a lower voltage per cell, so a greater number are required. Also the resistance of the alkaline electrolytes is higher. Therefore, a higher terminal voltage is required to overcome the voltage fall at high discharge rates.

The lead-acid battery was used in our tests. A typical volt-ampere characteristic for a particular size of positive plate is shown in Fig. 7. For a battery with 13 positive plates and a 10-hr rate of 165 amp/hr, the cell voltage falls to 75% (1.5 v), with a current discharge of 1000 amp.

The lead-acid battery used in combination with the 2-kw xenon lamp, produces a substantially square wave light output. Typical lamp voltages, lamp currents and light waveforms taken from oscillograms are shown in Fig. 8. The voltage waveform shown is measured at the lamp terminals. The open circuit battery voltage in this instance is 85 v. After ignition, the arc voltage starts at 43 v and rises to 52 v during the 100 msec flash. Increasing arc voltage, falling current and battery regulation maintain a constant lamp power and give a steady light output over the flash cycle.

A similar set of tracings for a flash of lower power also illustrates the square-wave form of the light flash. The rise

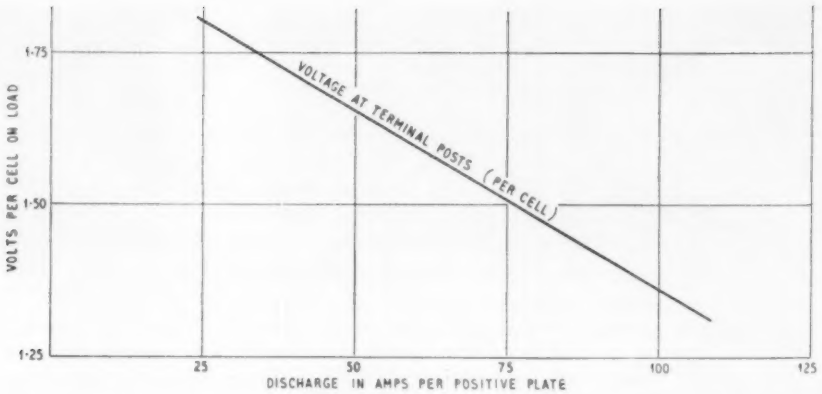


Fig. 7. Lead-acid battery discharge characteristic.

time to full light output is less than 2 or 3 msec; but the nigrescent time approaches 10 to 15 msec. The latter is dependent upon the time that the magnetic flux build-up takes to extinguish the arc.

Conclusions

Magnetic switching of the xenon arc is a simple method of controlling light flashes by switching off high currents which pass through a xenon lamp. The minimum flash duration is dependent upon the rate of magnetic flux build-up. Tests made with simple magnetic circuits show this to be about 10 msec. For pulses of shorter duration, additional factors such as supply voltage, cathode condition and de-ionization time must be considered.

There is up to 16% loss in light efficiency when a lamp is flashed from cold. This is advantageous in photographic techniques which require a flash of light that is not superimposed on a steady burning source. This efficiency loss can be overcome, however, by pre-burning the lamp to increase gas pressure and then allowing the anode to cool down prior to the flash cycle.

This principle of lamp operation provides an extension to the well known Cine Flash Unit that operates the 2-kw Xenon lamp from lead-acid batteries. With magnetic switching, a substantially square-wave pulse of light with a shorter flash duration is obtained with radiation of daylight quality. Measurements have shown that flash energies up to 15,000 wsec are possible, with light emission approaching a 1.5×10^6 lm.

As a result of work done in collaboration with Trinity House, magnetic switching of the 2-kw xenon lamp is successfully being used to control light flashes in the Dungeness Lighthouse.

Acknowledgments

The work on magnetic arc switching has been carried out in the Laboratories of the A. E. I. Lamp and Lighting Co. Ltd., Leicester, England. I am particularly indebted to T. J. M. Swan who has been directly concerned with the many measurements recorded in this paper. Valuable assistance has also been given to me by my other colleagues.

I would also like to thank the Admiralty Research Laboratories, Teddington, and the Mole-Richardson Co. (England) for permission to use illustrations of the 1–10-kw Mercury and Xenon Cine Flash Units. John Hadland has also shown considerable interest and has recorded high-speed photographs of arc extinction using magnetic fields.

References

1. D. P. C. Thackery, "Control of the actinic emission of electric discharges," *Proc. 3rd International Congress of High-Speed Photography*, Butterworths Publications, Ltd., 88 Kingsway, London W. C. 2; in U.S. by Academic Press Inc., 111 Fifth Ave., New York 3, 1956, pp. 21–29.
2. E. J. G. Beeson, "Prolonged flashes in xenon," *B. T. H. Activities 27:* 131–136, No. 4, July/Aug. 1956.
3. E. J. G. Beeson, "A high intensity light source for high speed kinephotography," *The Photographic Jour., 89B:* 62–67, May/June 1949.
4. H. K. Bourne and E. J. G. Beeson, "The Cine Flash and new lighting equipment for high-speed photography and studio effects," *Jour. SMPTE, 55:* 299–312, Sept. 1950.
5. E. J. G. Beeson, W. A. Bocock, A. P. Casiellain and F. A. Tuck, "The xenon lamp for film projection," *British Kinematography, 32:* 59–74, No. 3, March 1958.
6. (Patents Pending).
7. E. J. G. Beeson, Report submitted to 6th International Technical Conference on Lighthouses and Other Aids to Navigation, held in Washington, D.C., Sept. 26–30, 1960.

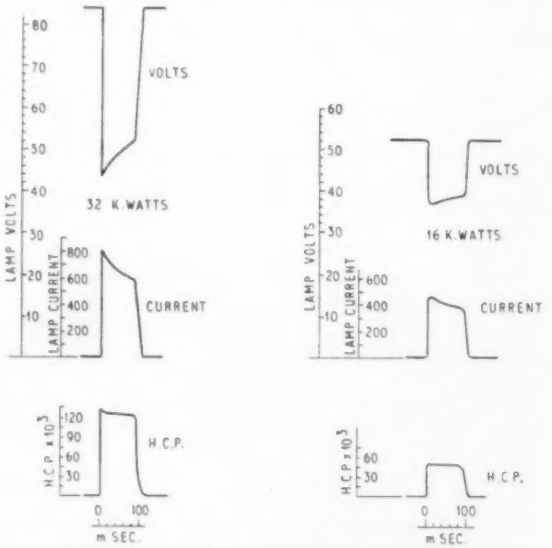


Fig. 8. Typical waveforms of a pulsed 2-kw xenon lamp.

Ed. Note: The Fifth International Congress on High-Speed Photography was sponsored by the SMPTE and supported in part by the Departments of Army, Navy and Air Force through a grant administered by the Chief Signal Officer of the Army. Congress papers and related discussion will be published in the *Proceedings* of the Congress.

Smear-Camera Techniques

By T. P. LIDDIARD, JR.
and B. E. DRIMMER

Various techniques have been developed which greatly increase the usefulness of the sweeping-image smear camera in detonation and shock-dynamics research. When self-luminosity is insufficient, several methods are used to enhance the light, e.g. Scotch Tape on explosive surfaces, air or argon gaps, etc. When required, external light is supplied by exploding wires, explosive flashlamps, etc. The sharp change in the intensity of light reflected from the surface of highly reflecting, opaque materials is used to record the arrival of shocks at the surface. When the reflectivity of the test surface is low, a covering of thin aluminized-plastic film is used, clearly signaling shock-arrival times. Very weak disturbances are observed by schlieren techniques, using either transmitted or reflected light. Multiple slits, or grid systems of various configurations can be used to increase the quantity of recorded information. "Light pipes" of optically clear filaments can be used to transmit light signals from points inaccessible to direct observation, to positions of alignment within a single slit, or to other convenient configurations. Other techniques are described, such as velocity-synchronization, shadowgraphing, time-dependent spectroscopy, and the use of color film.

In a recent article Brixner[2] described the construction and performance characteristics of the most advanced form of smear camera in use today. Such cameras, and their more simple predecessors, have played a significant role, especially in the last two decades, in the study of certain transient phenomena, such as those observed in detonations, shock dynamics, explosive loading, etc. The increased utility of these cameras is attested to by the fact that the authors have been consulted on numerous occasions about applications of these instruments to various research problems in these fields. We have found it helpful to our colleagues and to ourselves to summarize in one short article the different methods, systems and techniques that have been found useful in increasing the versatility of this instrument. It is to be emphasized that many of these methods are not "new" but are merely applications to smear photography of well-known photographic, optical or shock techniques.

Basically, a smear camera is an instrument which records continuously (as contrasted with intermittent recording, as in a framing camera) the changes of light intensity along a line, as a function of time. Using a detonating cylinder of explosive as an example, the modes of employment of the camera can be divided into three groups according to the orientations of the camera slit and optical axis to the axis of the explosive charge: (1) velocity measurement — slit parallel to cylinder axis, camera optical axis normal to cylinder axis; (2) time-of-arrival measurement — slit perpendicular to cylinder axis, camera optical axis parallel to cylinder axis; and (3) profile shot — slit and camera optical axis perpendicular to cylinder axis. It is this fundamental property of resolving in time the changes of light intensity along the slit that makes the camera so useful.

Generally, the method of employment of the camera is rather straightforward, as in the determination of the detonation rate in a cylinder, or a slab of explosive. Even here a few "tricks" can be applied to improve significantly the quality of the record. These improvements often produce acceptable records yielding data that otherwise would not have been obtained. The problem in smear camera photography can be simply stated: how can one cause a phenomenon, such as a shock wave, to produce light intensity changes (and thus signal its location) of sufficient magnitude to permit the camera to record the change? Obviously, if the slit is aligned in the desired manner along the path to be followed by the phenomenon, a position vs. time record is obtained, which, on analysis, can produce highly significant information. In this article the various systems and techniques used at NOL and other laboratories in conjunction with rotating-drum and rotating-mirror smear cameras are briefly discussed, and typical samples are shown of records obtained by such means.

Presented on October 20, 1960, at the Fifth International Congress on High-Speed Photography in Washington, D.C., by T. P. Liddiard, Jr. (who read the paper), and B. E. Drimmer, U.S. Naval Ordnance Laboratory, White Oak, Silver Spring, Md.

Simple Systems Without Auxiliary Light Sources

When the phenomenon is self-luminous, as in the detonation of an explosive, the light from the detonation front itself is used. The resulting record, however, frequently leaves much to be desired, especially if the luminosity is low. Considerable improvement in the quality of the record can be made by the simple expedient of pressing a transparent, plastic, pressure-sensitive tape (e.g., Scotch Tape) against the explosive charge, along the line to be viewed by the camera. If a series of fine, shallow lines (e.g., 0.005-in. deep by 0.010-in. wide) are scratched into the explosive beneath the tape, a series of sharp bright dots is recorded, simplifying the record-reading problem. A comparison between the results obtained with a bare explosive charge (Fig. 1) and with a charge employing tape and scratches (Fig. 2) shows clearly the benefits to be obtained by the latter technique.

Often a wave phenomenon (e.g. the arrival of a shock wave at a free surface) does not produce a luminosity of acceptable intensity. Increased luminosity can be obtained by using a material which, when shocked, produces the desired results. Two of the most frequently used light "intensifiers" are argon and air. The gas is placed in very thin channels, typically about 0.003-in. deep, within or on the surface of the test specimen. When the shock traverses this channel, a brilliant sharp light of short duration is emitted. Thus, a series of such

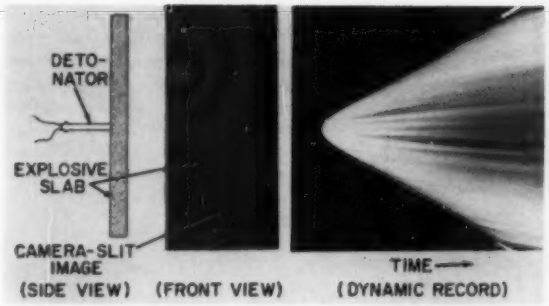


Fig. 1. Arrival of detonation at the bare front surface of an explosive slab initiated at mid-position of the rear surface.

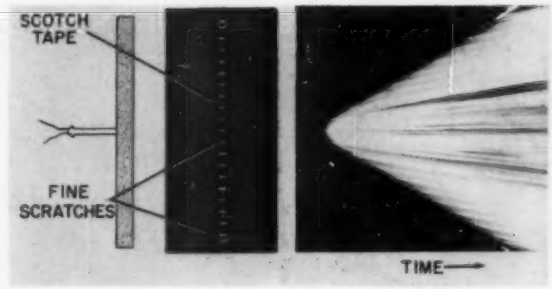


Fig. 2. Same experiment as Fig. 1. with fine reference lines scratched on the front surface of the charge, and Scotch tape pressed over this region.

channels, judiciously placed, could produce highly accurate space-time data. This method has found a great deal of use in obtaining experimentally determined equation-of-state data for solids for pressures ranging into the hundreds of kilobars.[1]

A variant of the shocked-argon system is to use plastic microballoons glued to the surface under observation. This method has also found utility in equation-of-state work on solids.[2]

Light-Reflection Systems

For events that are not self-luminous, some external intense light source is required, such as an exploding wire,[3] or shocked argon gas.[4] The light, reflected off the surface to be studied, acts as a mass-less probe, interposing no interference with the phenomena being observed. Apparently first used in 1953[5–7] we have found this system to be the basis of one of the most useful techniques to be employed with the smear camera. For example, Fig. 3 shows the arrival of explosive-generated shock waves at the free surfaces of aluminum and steel. The sharp change in light intensity clearly and instantaneously depicts the arrival of the shock wave at the surface. The delicacy of this system can be appreciated by noting the results obtained with steel, where the pairs of parallel lines are interpreted to indicate the arrival at the free surface of the faster-moving elastic wave ahead of the slower-moving plastic wave.

We have expanded the light-reflecting technique, for use with nonreflecting or poorly reflecting materials, by employing a thin (0.0006-in.) aluminized plastic (Mylar) film. By placing the 0.0001-in. thick aluminum layer against the surface to be studied and viewing through the transparent plastic, such surfaces are rendered highly reflective. Attachment of the plastic film to the surface is accomplished by adding a drop of water between the surface and the film, then pressing the film gently to remove the excess water. (The addition of a small amount of a surface-tension-diminishing detergent to the water is beneficial in this connection.) This system has found considerable use in this Laboratory in studying such processes as the build-up to detonation of an explosive under shock loading.[8,9]

Shadowgraph Systems

When reflected light is neither practical nor desirable, ordinary shadowgraph techniques are used. For example, Fig. 4 contains a shadowgram of the detonation of a thin slab of explosive immersed in water, from which highly accurate space-time data can be obtained. If the detonation wave moves normal to the explosive-water interface, by extrapolating the resulting water-shock velocities back to that interface, proper data can be obtained to permit a calculation of the Chapman-Jouguet pressure of the explosive.[10]

A variant on this scheme is to place the light source and the camera on the same side of the phenomenon under study. Behind the experimental subject is placed some highly reflecting material which is viewed by the camera. As the experiment progresses, the reflected light

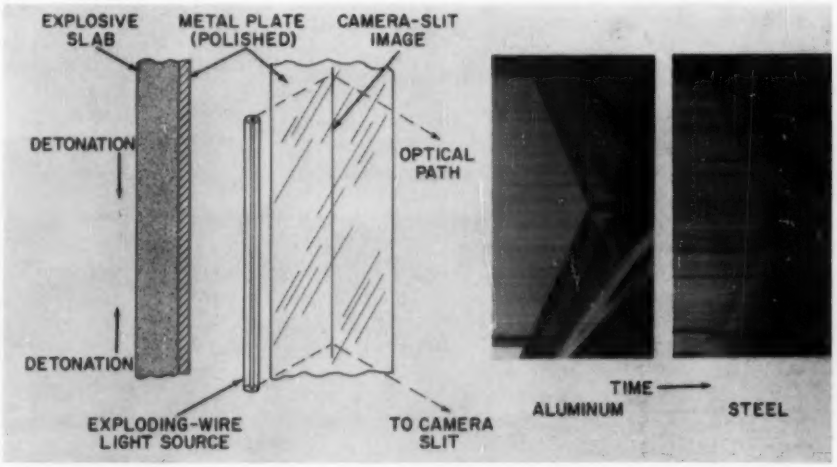


Fig. 3. Reflected light technique revealing the arrival of two colliding shock waves at the surface of a metal plate. The shocks were generated by two grazing detonation waves as shown in the figure at the extreme left.

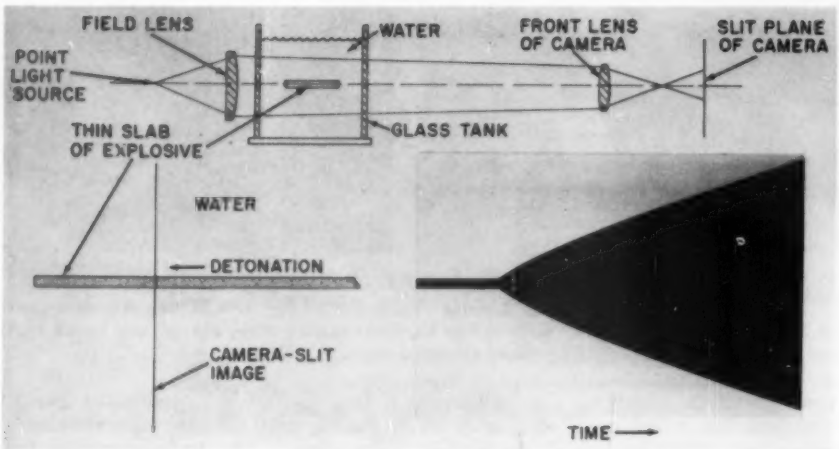


Fig. 4. Smear-camera shadowgram of the shock configuration produced by a thin sheet of explosive detonating under water. The upper figure shows the experimental arrangement and the figure at the lower left indicates alignment of the charge in relation to the camera slit.

is modified (or even extinguished) by either a shadow or a light-refracting mechanism (such as a shock), and thus space-time data are obtained. Various light-reflecting systems have been used successfully, such as mirrors or wires.[11] (Scotchlite reflectors have been used in framing-camera shadowgraph photography. The authors have found no references to such use with a smear camera, but can see no reason why it should not be applicable.)

When exceedingly small changes in light intensity are encountered, schlieren light systems are useful.[12] We have used it to photograph the extremely weak shocks transmitted in Plexiglas by an exploding wire (Fig. 5). In a similar manner, by placing the entire optical system (light source, camera, knife edge, etc.) on the same side of the subject, a schlieren picture with reflected light can be obtained. We have recorded very low-amplitude, low-velocity waves in solids in this manner.

Streak interferometry is another variant of shadowgraph technique which can be a powerful tool for studying transient phenomena.[13]

Multiple-Slit Systems

Normally, a smear camera records events occurring along a single line: the line immediately behind an exterior slit (i.e. a slit located at the phenomenon) or else the line along the projected image of a slit that is located at the camera itself. Increased information can often be obtained by the simultaneous use of several slits. These slits can be parallel or crossed, continuous or discontinuous, the exact configuration depending on the desired results. Thus five parallel slits were used in Reference 1 to obtain simultaneously data of shock-wave arrival over an area (rather than along a single line).

Discontinuous, parallel slits are sometimes more convenient, as shown in Fig. 6 where eleven discontinuous "slits", each consisting of 25 points, were used to record the formation of a Mach wave in Plexiglas formed by the collision of two regular shocks.[9]

Multiple slits need not necessarily be parallel; for selected purposes one can even have them intersect. Figures 7 and 8 are smear-camera photographs showing the arrival of a detonation wave at the face of an explosive plane-wave generator. In Fig. 7 five discontinuous slits plus one continuous one intersect at the center of the face of a four-inch diameter generator (which is viewed through a 0.25-in. thick glass plate placed 0.010 in. away from the generator face). The resulting dynamic record permits a simple analysis of the simultaneity of the time-of-arrival of the detonation front at the generator face. Figure 8 shows the results obtained in a duplicate experiment when using three continuous, intersecting slits.

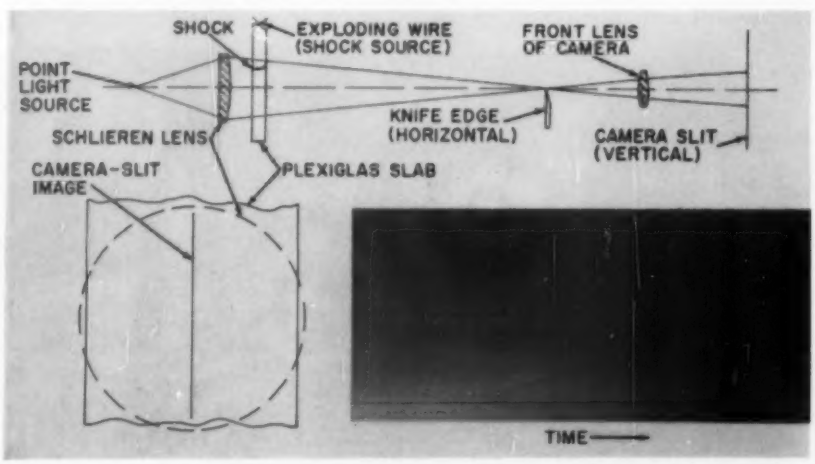


Fig. 5. A smear-camera schleiren photograph of weak shock waves generated in Plexiglas by an exploding wire. Such waves are too weak to be recorded by the shadowgraph technique of Fig. 4.

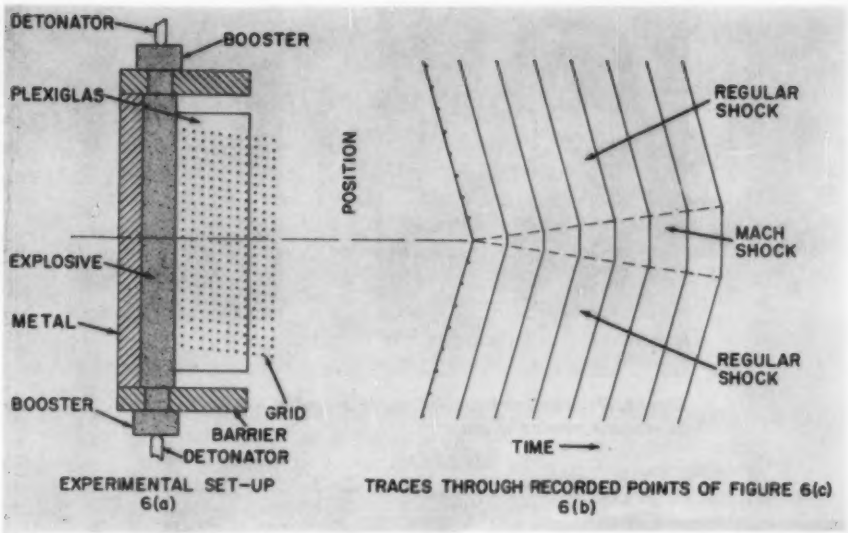


Fig. 6a, b. Use of a point-grid system in smear photography: Observations of a Mach Shock formed in Plexiglas by collision of two regular shocks.

Fig. 6(c). Record obtained from back-lighted experiment of Fig. 6(a).

Miscellaneous Systems

Upon occasion it is desired to observe the arrival of a shock or detonation wave at a point not directly observable by the camera. Mirrors are usually used in this case; however, occasions arise when even these cannot serve the purpose. We have found that light pipes[14] of 1-mm diameter glass rods gave acceptable signals (Fig. 9), thus permitting the camera to record time-of-arrival data at normally inaccessible points.

When the motion of a phenomenon is essentially uniform, the smear camera can be modified to produce a "still" picture. This is done in a relatively simple manner by matching the writing speed of the camera with the speed with which the image is displayed on the film.[15] Thus in Fig. 10 we have a "still" picture of a slab of explosive detonating in air. This technique has the salutary effect of increasing the time of exposure of the phenomenon, and thus finds occasional use in recording selected steady-state phenomena that emit only low-intensity light. A variant of this technique has been used at this Laboratory to measure fragment velocities.[16] In this method the anticipated velocity is approximately matched and the flying fragment is recorded as it passes between the drum camera and three lighted slits. This produces a photograph with three exposures, which by suitable analysis provides an accurate measure of the fragment velocity.

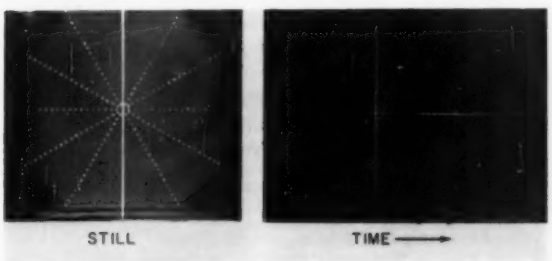


Fig. 7. Use of discontinuous, crossed, multiple slits to observe essentially simultaneous arrival of detonation front on face of a plane-wave generator.

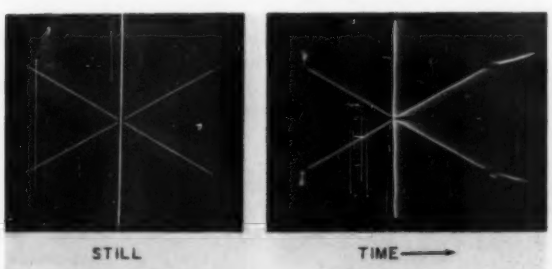


Fig. 8. Use of continuous, crossed, multiple slits in same experiment as Fig. 7.

The simple smear camera can be readily converted into a spectrograph by placing a transmission grating or a prism before the camera lens, using the camera slit as the spectrograph slit. These time-dependent spectra could then be converted to temperatures (e.g. detonation temperatures) by appropriate calculations. For highly luminous phenomena, such as an electrically exploded wire, these spectra are relatively easy to record.[17] The light from shaped-charge jets can also be recorded and analyzed by this means.[18] For phenomena emitting light of lower intensity, velocity synchronization permits longer exposures with resulting acceptable spectrograms.[15]

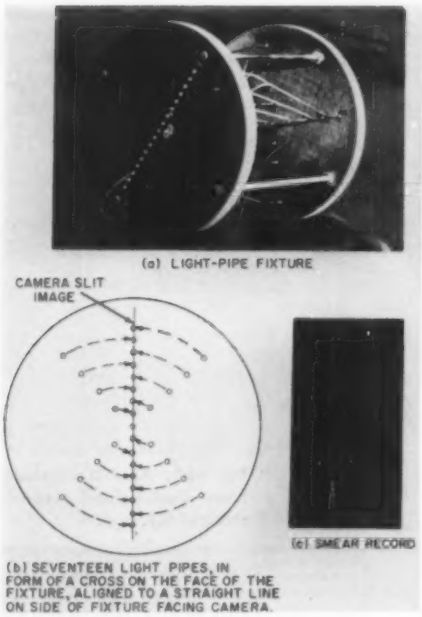

(a) LIGHT-PIPE FIXTURE
CAMERA SLIT IMAGE
(b) SEVENTEEN LIGHT PIPES, IN FORM OF A CROSS ON THE FACE OF THE FIXTURE, ALIGNED TO A STRAIGHT LINE ON SIDE OF FIXTURE FACING CAMERA.
(c) SMEAR RECORD

Fig. 9. Feasibility study of light-pipe application in smear photography: arrival of a detonation wave on the face of a plane-wave generator.

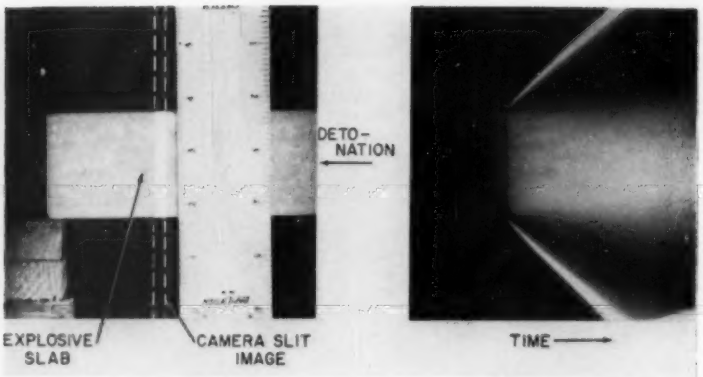


Fig. 10. Velocity-synchronized smear record of a slab of explosive detonating at constant velocity in air.

Finally, the use of color film has added another dimension to the smear camera. At NOL an unambiguous change was recorded in the wave length of light reflected from a metal free-surface when a shock wave reached the surface from within the metal.[19] (A color slide of this phenomenon was shown at the 5th International Congress on High-Speed Photography; October 1960; Washington, D.C. Since the significant features of this photograph would be lost in black-and-white reproduction, no copy was included for this publication.) Exploitation of the potentialities of this new tool has only begun!

In conclusion we would like to make clear that the above discussion was not designed to be a comprehensive study of the history, theory and practice of smear-camera photography. Selected references, generally of the more recent (and presumably of the more advanced) vintage, have been cited more as guides than to establish precedence. It is hoped that such a short summary will serve not only as a useful reference to aid the beginner in learning and applying smear-camera photography, but will also serve as a stimulus to the more advanced practitioner to develop additional techniques, making even more useful this highly versatile tool.

Finally, the authors wish to acknowledge with gratitude the many helpful suggestions and the guidance furnished by Dr. S. J. Jacobs of this Laboratory.

References

1. J. M. Walsh and R. H. Christian, "Equation of state of metals from shock wave measurements," *The Physical Review, 97:* 1544 (1955).
2. W. E. Deal, "Measurement of the reflected shock hugoniot and isentrope for explosive reaction products," *The Physics of Fluids, 1:* 523 (1958).
3. T. P. Liddiard, Jr., and R. D. Drosd, "Exploding wires for light sources in fast photography," NOLM 10840, (1950).
4. OSRD Div. 8 Interim Report DFA-8, "Detonation, fragmentation, and air blast," Mar. 15, 1944 to Apr. 15, 1944 (Confidential).
5. W. A. Allen and C. L. McCary, "Experimental technique to measure transient waves through solids," *Rev. Sci. Inst., 24:* 165 (Feb. 1953).
6. T. P. Cotter, "The structure of detonation in some liquid explosives," Doctor's Thesis, Cornell University (Sep. 1953).
7. D. C. Doran, G. R. Fowles and G. A. Peterson, "Shock-wave compression of aluminum," *Physical Review Letters, 1:* 402 (Dec. 1958).
8. J. M. Majowicz and S. J. Jacobs, "Initiation to detonation of high explosives by shocks," presented at Lehigh Meeting of Fluid Dynamics Div., Am. Phy. Soc., Nov. 1957 (based on classified NAVORD Report 5710, 1958, not available).
9. S. J. Jacobs, "Examples of high speed photographic techniques at the Naval Ordnance Laboratory," *Proc. 4th International Congress on High-Speed Photography*, Verlag Dr. Othmar Helwich, Hoffmannstr. 59, Darmstadt, Germany, 1959.
10. W. C. Holton, NAVORD Report 3968 (1 Dec. 1954). (Classified report not available to general public.)
11. F. D. Bennett and D. D. Shear, "Visualization of cylindrical shock waves," *The Physics of Fluids, 2:* 339 (1959).
12. H. S. Pickering and J. W. Linnett, "Schlieren technique for low luminosity velocity," *Trans. Faraday Soc., 47:* 989 (1951).
13. F. D. Bennett, D. D. Shear and H. S. Burden, "Streak interferometry," 12th Annual Gaseous Electronics Conference, Washington, D.C., Oct. 1959. (*APS Bulletin; Series II, 5:* p. 133; Mar. 1960.)
14. N. S. Kapany, "Fiber optics. Part I," *J. Opt. Soc. Am., 47:* 413 (1957).
15. T. P. Cotter and S. J. Jacobs, "Studies pertaining to the measurement of temperatures in a detonating explosive," OSRD No. 5618 (1946).
16. A. D. Solem, B. N. Singleton, Jr., "The NOL fragment velocity range," NAVORD Report 2766 (1953).
17. S. Smith, "A study of electrically exploded wires," Mt. Wilson Contrib. No. 285; *Astrophysical Jour., 61:* 186 (1925).
18. W. C. White, J. S. Rinehart and W. A. Allen, "Phenomena associated with the flight of ultra-speed pellets. Part II. Spectral Character of Luminosity," *J. Appl. Phys., 23:* 198 (1952).
19. N. L. Coleburn, M. Solow, and R. C. Wiley, "Shock induced luminescence," *Bull. Amer. Phys. Soc., II, 5:* 201 (1960).
20. B. Brixner, "An improved f/10 sweeping-image camera," *Jour. SMPTE, 69:* 109 (1960).

Ed. Note: The Fifth International Congress on High-Speed Photography was sponsored by the SMPTE and supported in part by the Departments of Army, Navy and Air Force through a grant administered by the Chief Signal Officer of the Army. Congress papers and related discussion will be published in the *Proceedings* of the Congress.

The Core Camera: Continuous Receptivity — One Rotating Element

By J. N. WHYTE

The advantages of a streak camera having continuous receptivity and employing only one rotating element are discussed. The essential element of such a camera is a prism-mirror combination which is rotated at high speed. Various arrangements of this combination are possible, and have been investigated with a view to compensating for the aberrational and "splitting" effects. The theory of image formation through the combination is reviewed and alternative schemes are discussed.

THE ADVANTAGES of a film drum camera in which the film drum remains stationary and a mirror is rotated at high speed in order to sweep the image around the film drum, has been treated exhaustively in the literature. The alternative method of forming the image on to a rotating film drum has also been used.

In the former case, the event has to be synchronized with the mirror position. In the latter case, one has to contend with the greater mass of moving parts and the subsequent reduction in writing speed, although such a camera does give continuous receptivity. On the other hand, the film drum camera with moving optical parts has the advantages of potentially higher writing speed in the chronograph role and higher frame rates in the cine role (i.e., the recording of discrete pictures of the event).

Various attempts have been made to produce a stationary film drum camera using moving optical parts and having continuous receptivity. It is considered that these have not been entirely satisfactory. Those systems which give continuous receptivity require an image rotation compensation device which must also be rotated at high speed and, in general, at a different speed from that of the main sweep mirror. Those which do not require image rotation do not give continuous receptivity without sacrifice of illumination (e.g., beam-splitting) and considerable optical complexity.

A camera, either streak or cine, containing the best of both systems can be specified as follows:

(i) continuous receptivity,
(ii) one rotating optical system,
(iii) "in-line" film recording for ease of analysis, and
(iv) no unnatural reduction of the illumination available.

Such a camera can be achieved by the use of the optical system to be described, and the description is confined to a streak camera.

Presented on October 20, 1960, at the Fifth International Congress on High-Speed Photography in Washington, D.C., by J. N. Whyte, Armament Research & Development Establishment, Sevenoaks, Kent, England.

Prismor System

A prism-mirror combination, which has been named "prismor," has been investigated and manufactured in a variety of forms at Fort Halstead with encouraging results. These have been found to have many applications.*

The arrangement consists of an optical glass block comprising two isosceles prisms cemented together at their base, the interface being silvered. Figure 1 shows three possible arrangements, each having the property of sweeping the incident beam through 360° in the plane of the paper. The choice of shape depends upon the particular application. The best compromise for application to a streak camera is the right-angled block shown in Fig. 1(c).

When the prismor is inserted in a parallel beam the path of the rays for an axial beam is shown in Fig. 2, the parallel beam being undeviated. It will be noted that the optical axis is split by a distance D. It can also be shown that the separation of the split optical axis is given by

$$D = 2H\left\{2\sin^2\frac{\alpha}{3} - \tan\left(\sin^{-1}\left[\frac{\sin\frac{\alpha}{2}}{n}\right]\right)\sin\alpha\right\}$$

where n = refractive index of the material
α = apex angle of the prism, and
H = height of a single prism.

For example, for a 90° prism, assuming $n = 1.5$

$$D = 0.93H.$$

Application to Streak Camera

The general arrangement of the optical components in a streak camera is well known. Briefly, the event to be studied is focused by means of a lens on to a narrow slit, this slit being projected via a rotating reflecting element on to the film wrapped round the inside of a drum. The rotating reflecting element is generally a double-sided

* *Instrument Practice, Vol. 14,* No. 1, Jan., 1960.

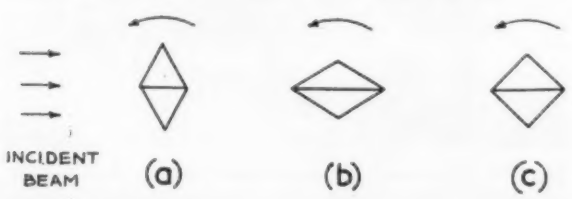


Fig. 1. Prismor shapes.

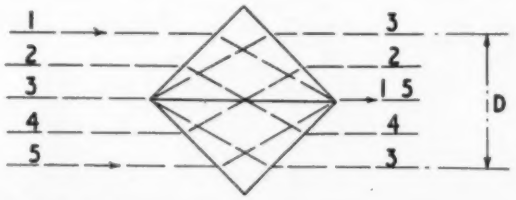


Fig. 2. Path of rays.

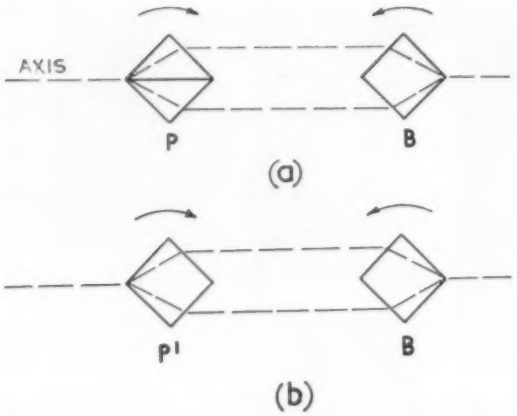


Fig. 3. Compensation for image splitting.

mirror or a multi-sided reflecting block. It is these particular rotating elements which it is proposed to replace by the prismor arrangement.

In this arrangement the prismor would be placed in a converging beam, therefore it is necessary to consider the effects of both aberrations and image splitting. Since it was felt that the image splitting effect might be the more pernicious, this is considered first.

Prismor Arrangement in Conjugate Beam

In Fig. 3(a), P is the prismor and B is a plane glass block of the same material and equal shape.

The refracting equivalent of the reflecting prismor is P'. To analyze the effect and compensation of splitting, Fig. 3(b) shows that the optical axis which is split by the prismor is brought into coincidence by the contra-rotating block. This condition is maintained throughout rotation.

This arrangement, as it stands, does not, of course, meet our original specification of one rotating element. Thus the arrangement illustrated schematically in Fig. 4 is adopted.

The object O is focused by lens L on to the slit S. The slit is projected via the plane right-angle block P_2 and stationary mirror M, through the prismor P_1, on to the stationary film track. P_2 and P_1 are cemented together, in line, and rotate on a common spindle. The slit image is swept continuously around the circular stationary film track.

A model camera was constructed to confirm the theory and is shown in Fig. 5. In this camera no attempt was made to compensate for the aberration effect of two rotating, refracting elements placed in the converging path. The definition was consequently inferior.

It will be noted that the system operates off-axis. This is to ensure that the image lies in the plane of the film. This off-axis angle α can be determined from the relationship

$$\alpha > \tan^{-1}\frac{H}{4x}$$

where H is the height of the plane block or the prismor, and x is the distance from the plane of the prismor face to the plane of the stationary mirror when these two planes are parallel.

Effect of Optical Path in Glass

As a result of the path in glass, the aberration contributions are of two types: one is constant, and the other cyclically variable. The constant aberration contributions can be reduced by redesign of the elements in the optical train. The cyclically varying aberrations, however, cannot be so easily reduced. Distortion, coma, and axial chromatic aberration are matched by virtue of the contra-rotation of the blocks; but the cyclic contribution of astigmatism is additive. Means of compensating for this defect are currently being investigated.

Collimated Beam Core Camera

Further investigation has shown that an alternative arrangement is possible whereby there is no aberration contribution due to the path in glass, no cyclic variation of aberration, and no splitting effect. Such a camera is shown schematically in Fig. 6.

Light from the slit S is collimated by lens L, passed through the prismor P, and focused by means of the annular mirror M on to the stationary film drum F. The radius of the annular mirror M is equal to its perpendicular distance from the axis of rotation of the prismor. To keep the prismor as small as possible, the entrance pupil to the mirror M is arranged to fall on the axis of rotation.

In order to ensure that the film drum does not obscure any of the light from the annular mirror, it is necessary for the system to work off-axis.

In Fig. 7, H represents the semiaperture of the system which is approximately equal to the length of the prismor along the rotational axis of the prisms. The principal ray passes through the center of this pupil making an angle α with the horizontal. On reflection from the mirror M, it forms the center of the image of semi-height h on the film drum. The upper ray makes an angle $(\alpha + \Delta)$ with

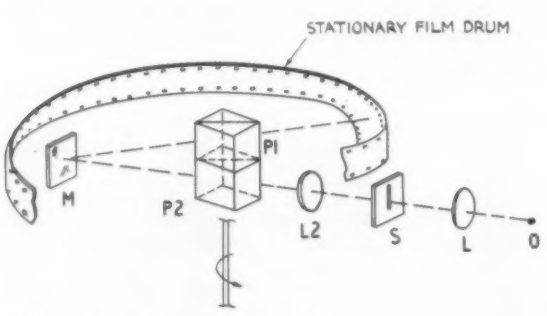


Fig. 4. Schematic representation of camera.

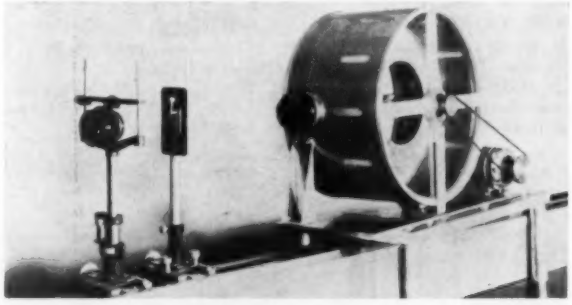


Fig. 5. Model camera. (Crown copyright reserved. Published with permission of the Controller of Her Britannic Majesty's Stationery Office.)

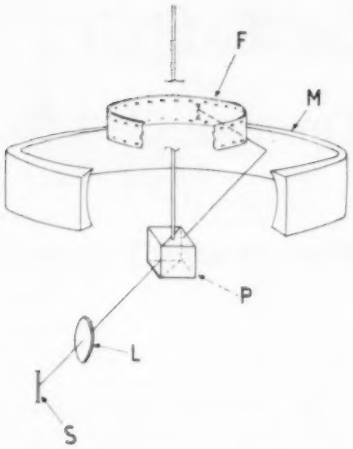


Fig. 6. Collimated beam core camera.

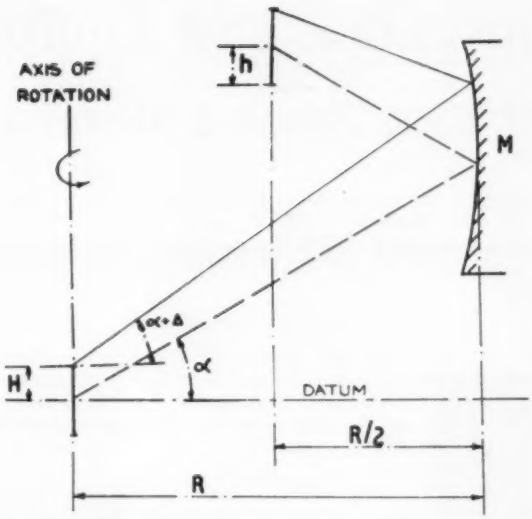


Fig. 7. Ray diagram.

Fig. 8. Caged prismor.

the horizontal. The mirror M has radius R and focal length $R/2$. Then the incident height of the principal ray on film drum from the datum line

$$= \frac{3R\alpha}{2}$$

Height from datum to bottom of image

$$= \frac{3R\alpha - h}{2}$$

$$= \frac{3R\alpha - R\Delta}{2}$$

Incident height of upper ray in plane of film drum

$$= \frac{R}{2}(\alpha + \Delta) + H$$

$$\therefore \frac{3R\alpha - R\Delta}{2} \geq \frac{R}{2}(\alpha + \Delta) + H$$

Rearranging the terms

$$\alpha \geq \Delta + \frac{H}{R}$$

Since the entrance pupil to the mirror has a diameter $2H$ and focal length $= R/2$, the f-number of the camera

$$= \frac{R}{4H}.$$

$$\therefore \alpha \geq \Delta + F/4 \text{ } (f\text{-number})$$

For ease in manufacture and assembly the mirror is segmented. The number of segments is at least 24, irrespective of the size of the mirror. This is to ensure that the segments are cut with an aperture ratio not higher than $f/2$.

Dynamic Considerations

The usefulness of both cameras is, to a great extent, dependent upon the speed with which either the single or compensated prismor can be rotated. This is the subject of a current design study contract. The dynamic performance of the prismor combination is being studied with a view to determining the factors which limit the upper speed of rotation.

It seems likely at this stage of development that the adhesion of the two halves of the prismor (or the cohesion of the aluminized film to the base) may be a limiting factor. There may be some merit in leaving a small size gap between the two aluminized surfaces. Alternatively, the tensile strength of the glass may be a limiting factor, resulting in either deformation or fracture at very high speeds. The effect of strengthening the prismor by surrounding it in a metal cage, as shown in Fig. 8, is being investigated.

Ed. Note: The Fifth International Congress on High-Speed Photography was sponsored by the SMPTE and supported in part by the Departments of Army, Navy and Air Force through a grant administered by the Chief Signal Officer of the Army. Congress papers and related discussion will be published in the *Proceedings* of the Congress.

89th Convention and Equipment Exhibit

Hotel King Edward Sheraton, Toronto, Canada, May 7–12

Theme: International Achievements in Motion Pictures and Television

Gerald G. Graham, now the Arrangements Chairman, was chairman of the Planning Committee for the Toronto Convention.

THE 89TH CONVENTION has benefited from long-range planning and much careful work during the past two years. The first formal report of the Toronto Planning Committee for the 89th SMPTE Convention was made on September 21, 1959, by Chairman Gerald G. Graham. The Papers Program planning was begun in mid-1959 by Rodger J. Ross. The results of his leadership are shown below in the Advance Outline of Sessions. The Advance Program, complete with abstracts of about 100 papers, will appear in the March *Journal*.

Convention Arrangements

Since publication of the roster of Local Arrangements Chairmen in the October *Journal*, there have been some additions. The revised list of the many who are responsible is:

Local Arrangements Chairman: GERALD G. GRAHAM
Vice-Chairman, Local Arrangements: ROGER BEAUDRY
Exhibit Chairman: KENNETH S. OAKLEY
Exhibit Committee: BOB MACKENZIE and PETE ELLIOTT
Hotel Arrangements: LOU T. WISE
Registration Chairman: DON DIXON
Auditors: JIM BACH and DON CLAYTON
Ladies Program: FRANK TATE
Co-Hostesses: MRS. S. W. CALDWELL and MRS. F. L. TATE
Public Address, Recording and Projection Chairman: AL TURNBULL
Special Assignments: R. S. (TEX) REKERT
Banquet Chairman: ARTHUR CHETWYND
Luncheon Chairman: SPENCE CALDWELL
Publicity Co-Chairmen: ARTHUR C. BENSON and FRANK YOUNG
Hospitality Chairman: MRS. A. L. CLARK
Hospitality Committee: MRS. W. G. FARROW, MRS. E. POTTER and MISS J. ALLEN
Membership Chairman: JIM BUIST
Membership Committee: BERNARD MCALLISTER and N. J. VALIN
Transportation Chairman: RON RINGLER
Administrative Assistants: NORMAN OLDING, E. WALLY HAMILTON, A. H. SIMMONS, R. R. EPSTEIN and MICHAEL STECHLY

All indications are that the Toronto Convention will be a very well run show and a very good one. More information will appear in the announcement soon to be mailed to all members. That will include the convenient Hotel Reservation Card customary in such Society mailings. The rates are shown later, below.

The Papers Program

News from Chairman Ross is consistently good, with the facts, both stated and inferred, justifying an optimistic view and a confident prediction of a four-star, A-1 Convention. For example: Close to 80 papers were scheduled early and planned to fit into this *Advance Outline of Sessions*.

Monday, May 8, Morning: special cinematography including a demonstration of the Super Technirama 70 Process
———*Afternoon:* instrumentation and high-speed photography
———*Evening:* film and television in education

Tuesday, May 9, Morning and Afternoon: new developments in 8mm
———*Evening:* film projection equipment and practices including xenon rear projection and a 70mm Italian projector

Wednesday, May 10, Morning: sound recording and reproduction — control equipment, special effects, review room practices
———*Afternoon:* demonstration lectures with new equipment

Thursday, May 11, Morning and Afternoon: laboratory practices including rapid processing and papers by Technicolor Corp.
———*Evening:* television recording including a mobile color TV unit, editing video tape, standards conversion

Friday, May 12, Morning and Afternoon: TV studio practices and station operation including two papers from Japan and from England, two papers on studio lighting

The above wealth and width of program is based on the effective activities of the thirteen Topic Chairmen listed in the October *Journal*, p. 752.

Motion-Picture Short Subjects

Ralph Ellis is Chairman for this important part of the Program which will show fruits of technical and filmic efforts from many countries. A tentative list of 14 films was given in the November *Journal*, p. 826.

Hotel Reservations

There will be no Advance SMPTE Registration for Papers Program and Entertainment Events at the Toronto Convention. All members are urged, however, to make their Hotel reservations as soon as possible. As noted above, the Convention Announcement with hotel card is being mailed very soon to all members. The rates are shown below, if you wish to

write now to: *Reservation Office Manager*, King Edward Sheraton Hotel, 37 King St. East, Toronto, Ont.

Single room:
$6.50, $7.50, $9.50, $10.50

Double Room:
$11.50, $12.50, $14.50

Suite occupied by one person
$16.00, $20.00, $28.00, $32.00

Suite occupied by two persons
$20.00, $25.00, $33.00, $38.50

Suite (2 rooms and parlor) occupied by 4 persons
$40.00, $58.50

Entertainment

A new Society feature will be a Sunday Buffet — 7:30 P.M. — and a feature film to be shown at 9:15 P.M. The Get-Together Luncheon, the Banquet and Dance, and the Ladies Program will all be described in detail in the announcement and in the March *Journal*.

The Convention City

"Cosmopolitan as Paris and New York and as friendly and hospitable as Texas," is how one tourist has summed up his impressions of Toronto. The city has a long and interesting history. It is rather a nice coincidence that "Toronto" is a Huron Indian word that can mean either "place of meeting" or "plenty," both appropriate on this occasion.

In 1750 a fort was built by the French on a site that is now the foot of Dufferin Street. Fort Toronto, as it was then called, was burned in 1759 by the French to prevent its being taken by the British. In 1788 the site of the present Toronto was purchased from the Indians by the British (for a hundred or so blankets and some axes) and by 1793 a thriving town had been built. Then, alas, the picturesque Indian name was changed to York. Then came the War of 1812, and the Americans marched into the town, destroyed the fort, the legislative buildings and the archives, and not content with all that devastation, the rude fellows then carried off the Mace. A very short time later the British retaliated by burning much of Washington, D.C., including the White House. It has been almost a century and a half since these wild doings, and much has happened since, but it was not until 1934 that Toronto regained its Mace. This symbolic object was returned by President Franklin D. Roosevelt, 100 years after the town became a city. Its name was formally changed back to Toronto in 1834.

In the past two decades the town has been growing with enormous rapidity. The St. Lawrence Seaway is expected to bring millions of tons of overseas commerce to the Port of Toronto.

With these few notes — just the barest hint of what to look for in Toronto — the visitor with some leisure will find a walking tour of the city, with special attention to landmarks of the past, a rewarding experience.

Equipment Exhibit

All the space originally planned for exhibits (47 booths) has been reserved and an additional room, which was to have housed the Kodak Coffee Club, has been turned over to exhibits and already partially filled. Luckily for coffee drinkers, a new location for the Coffee Club has been found, just off the Registration area.

Plans are under way for a number of Canadian Government displays, illustrating motion-picture and television activities of the Air Force, Navy, National Research Council and National Film Board. The Canadian Broadcasting Corp. will have a 4-booth display.

The latest list of confirmed exhibitors is as follows:

A.T.R. Armstrong Ltd. (Canada)
Bach Auricon, Inc. (U.S.)
Beckman & Whitley, Inc. (U.S.)
Bell & Howell Co. (U.S.)
Behrend Cine Corp. (U.S.)
Braun of Canada Equipment Ltd. (Canada)
Caldwell A/V Equipment Ltd. (Canada)
Camera Equipment Co. (U.S.)
Canadian Broadcasting Corp. (Canada)
Canadian Applied Research Ltd. (Canada)
Alex L. Clark Ltd. (Canada)
Eastman Kodak Co. (U.S.)
E.M.I. Cossor Electronics Ltd. (England)
Ferrania Div., Viditon Corp. (Canada)
Film Editing Equipment, Inc. (U.S.)
Florman & Babb, Inc. (U.S.)
Harwald Co. (U.S.)
Philip A. Hunt Co. (U.S.)
Lipsner-Smith Corp. (U.S.)
MacKenzie Equipment Ltd. (Canada)
Magnasync Corp. (U.S.)
Magna-Tech Electronics Co., Inc. (U.S.)
McCurdy Radio Industries Ltd. (Canada)
Motion Picture Enterprises, Inc. (U.S.)
Northern Electric Co. (Canada)
Precision Cine Equipment Div. (U.S.)
Robert Rigby Ltd. (England)
L. B. Russell Chemicals, Inc. (U.S.)
See Cue Devices Ltd. (Canada)
S.O.S. Cinema Supply Corp. (U.S.)
Strand Electric Ltd. (Canada)
Thompson Products Ltd. (Canada)
W. Vinten Ltd. (England)
Wollensak Optical Co. (U.S.)

The Equipment Papers and Demonstrations Session on Wednesday afternoon, May 10, at which exhibitors will have an opportunity of describing and showing some of their new products, will be under the chairmanship of M. M. Elliott, of S. W. Caldwell Ltd. For whatever space may be left, last-minute would-be exhibitors should contact the Exhibit Chairman, Kenneth S. Oakley, c/o Bell & Howell Canada Ltd., 88 Industry St., Toronto 15, Ont. (RO 7-3131).

Education, Industry News

The American Society of Photogrammetry (ASP), 1515 Massachusetts Ave., N. W., Washington 5, D. C., and the American Congress on Survey and Mapping (ACSM), Room 30, Woodward Bldg., 733 15th St. N.W., Washington 5, D.C., will hold a joint convention March 19–25 at the Shoreham Hotel, Washington D.C. Theme of the joint meeting will be new developments in space mapping. Full size models of recently launched Earth satellites will be on display through the courtesy of the National Aeronautics and Space Agency. Subjects to be covered during the technical sessions will include Automation in Mapping; A Geologic Map of the Moon; Aerial Survey of the Makong River; and New Techniques in Aerial Photography.

Although the convention is held jointly, the time will be divided between the 27th Annual Meeting of the ASP (March 20 through the morning of March 22) and the 21st Annual Meeting of the ACSM (afternoon of March 22 through the afternoon of March 24). Registration for the joint convention (both meetings) begins 5:30 P.M., Sunday, March 19. The convention will close with a dance held Friday evening. ASP Program Chairman is Paul Alban. ASCM Program Chairman is John M. McAlinden.

The 30th Annual Meeting of the Inter-Society Color Council, to be held April 10–12, 1961, in Rochester, N.Y. (*Journal*, p. 46, Jan. 1961), will be followed by the Maxwell Colour Centenary, marked by a Conference arranged by the Colour Group in collaboration with the Inter-Society Color Council and the British Institute of Physics and the Physical Society. The Conference will be held May 16–18, 1961, at the Royal Institution and at the Imperial College of Science and Technology, South Kensington, London, S.W.7. This meeting will be followed by the International Colour Meeting to be held May 23–26, 1961, at Düsseldorf, Germany.

The London Conference commemorates the date of May 17, 1861, when James Clark Maxwell gave his famous demonstration of trichromatic color reproduction at the Royal Institution in London. Subjects for discussion for the three-day Conference will include Trichromatic Principles, Color Reproduction, and Color Appearance. Further information is available from The Institute of Physics and the Physical Society, 1 Lowther Gardens, Prince Consort Road, London, S.W.7, England.

Theme of the International Colour Meeting at Düsseldorf will be Practical Applications of Colour Science. Main topics of discussion will be Color Metrics, Physiology, Psychology, Esthetics; Color Techniques; and Color Education, Documentation.

The Annual Convention of the Society of Photographic Scientists and Engineers will be held May 22–26, 1961, in Binghamton, N.Y. Main emphasis of the technical program will be on recent advances in color and black-and-white photography. Many papers will deal with photographic applications to space technology. A few representative papers selected from those scheduled for presentation are "Enhancement of Print-Out Effect by Bathing Treatment," by Yoshitada Tomoda, Japanese Government Research Institute, Tokyo; "Standardization of the Correct Exposure of Color Reversal Films Under the Aspect of the Probability Theory," by W. Behrend, Agfa Research Laboratories; "The Contrast Transmission of a Sinusoidal Signal of Large Amplitude by Photographic Means, by Henri Thiry, University of Liège, Belgium; "Effect of Temperature of Exposure on Photosensitivity and the Rate of Development," by T. H. James, Eastman Kodak; and "The Electrolytic Removal of Thiosulfate from Processed Photographic Papers," by R. E. Rice, Ansco. General Program Chairman is M. G. Anderson, Director of Operations and Product Technology, Ansco Div., General Aniline & Film Corp., Vestal Pkwy. East, Binghamton, N.Y.

The IRE has been awarded a grant of $10,000 by the National Institutes of Health and a grant of $5000 by the National Science Foundation for the support of the 4th International Conference on Medical Electronics (*Journal*, p. 48, Jan. 1961). The Conference will be held July 16–21 at the Waldorf Astoria Hotel, New York. The preceding conferences were held in London, 1960, and in Paris, 1958 and 1959. Associated with the Conference will be an Exhibition to display techniques and equipment in the medical electronics field.

A symposium on the technical aspects of sound and sound equipment application in industrial and educational motion pictures, television and radio, sponsored by Behrend Cine Corp., 161 E. Grand Ave., Chicago 11, will be held March 30–31 at the St. Clair Hotel in Chicago. Fifteen experts on sound and film will present papers on various topics including recorder and microphone types and characteristics, recorder accessories and associated equipment, synchronizing methods, power supplies, testing methods and audio equipment.

The Convention on Television and Film Techniques, jointly sponsored by the British Kinematograph Society and by the (British) Television Society will be held April 20–21, 1961, at the Institution of Electrical Engineers, Savoy Place, London W.C.2. The opening address will be delivered by Sir Harold Bishop, Director of Engineering, BBC. Papers scheduled for the technical program include (April 20) "The Use of Videotape for Colour Television Recording," by J. Roizen, Ampex International, S.A., Switzerland; "Viscomatic Processing," by B. J. Davies, Kodak Ltd.; "Recent Progress in the SECAM FM Colour Television System," by J. Polonsky and M. M. Sauvanet, Compagnie Générale de Télégraphie sans Fil; "Thermoplastic Recording," by W. E. Glenn, GE Research Laboratories, Schenectady, N.Y.; on (April 21) "The Eidophor," by Prof. E. Baumann, Institut für Technische Physik der ETH, Zurich, Switzerland; "Technical Requirements of Systems and Film for Colour Television," by T. G. Veal and F. A. Richey, Eastman Kodak Research Laboratories, Rochester, N.Y.; "Colour Television Engineering: Studio Problems and Techniques," by A. R. Stanley and J. Treays, BBC; "Colour Television Engineering: Equipment Problems and Techniques," A. R. Stanley and S. N. Watson, BBC.

Registration fee is £3 3s 0d. A few extra Reservation Forms, Hotel Reservation Forms and Programs were sent to the SMPTE Editorial Office and will be made available upon request as long as the supply lasts.

The 31st Annual Meeting of the Biological Photographic Association will be held August 21–24, 1961, at the Pick-Congress Hotel, Chicago. In charge of the papers planned for presentation is Jack P. de Bruin, Presbyterian-St. Luke's Hospital, Dept. of Photography, 1753 W. Congress Parkway, Chicago 12. Mervin W. LaRue, Sr., is Vice-President and General Chairman.

The 5th Midwest Symposium on Circuit Theory, sponsored by the IRE Professional Group on Circuit Theory, will be held May 7–8, 1961, at Allerton Park and the Urbana Campus of the University of Illinois. The Symposium will be devoted exclusively to contributions in network topology and graph theory, including analysis and synthesis applications in active and passive networks, information networks, switching circuits, and related topics.

An International Symposium on the Transmission and Processing of Information will be held September 6–8, 1961, at the Massachusetts Institute of Technology, sponsored by the IRE Professional Group on Information Theory in cooperation with the Center of Communication Sciences, Research Laboratory of Electronics, MIT. The purpose of the Symposium will be to provide opportunity for presentation of significant research contributions of either a theoretical or experimental nature. The program is being planned specifically for active specialists in the field. Program Chairman is Peter Elias, RLE, MIT, Cambridge 39, Mass.

The Society for Visiting Scientists (SVS). 5 Old Burlington St., London W.1, was established during World War II to provide a meeting place for foreign scientists and British Scientists. The Society provides club and restaurant facilities and overnight accommodations for a limited number of visitors. The SVS is also headquarters for the Overseas Science Students Association. President of the Society is Professor A. V. Hill. Further information is available from the Assistant Secretary, Miss E. Simpson, at SVS headquarters.

Announcement of the purchase of 650 Altec Lansing Voice of the Theater speaker systems by Cinerama, Inc., has been made by Altec Lansing Corp., of Anaheim, Calif. The systems are to be installed in 50 new Cinerama theaters and each theater will contain a set of 13 speaker systems consisting of the basic A4 and A7 systems.

NEWS from the far corners of the world

..filmed with AURICON 16mm Filmagnetic Cameras and SOUNDCRAFT Magna-Stripe raw stock!

News-gathering services all over the world bring Talking-Pictures with "Living Sound" to America's 45 million television screens—filmed with the incomparable Auricon Filmagnetic Camera and Soundcraft's Oscar-winning Magna-Stripe raw stock.

Magna-Stripe, Soundcraft's exclusive method of putting magnetic stripes on film, is unaffected by photo developing processes.

Using Auricon Filmagnetic Cameras loaded with Magna-Stripe raw stock, you get highest picture quality and all the advantages of magnetic tape **—with no signal loss in transfer from the original to the final print!**

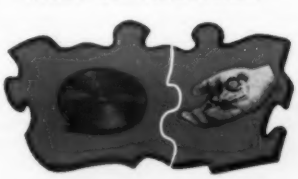
If it's news you're after, or the production of commercial and industrial sound-films, use Auricon Filmagnetic Cameras and Soundcraft Magna-Stripe raw stock—for high-fidelity results in single-system filming!

AURICON EQUIPMENT
IS SOLD WITH A 30 DAY MONEY-BACK GUARANTEE
AND A ONE YEAR SERVICE WARRANTY

Write for complete information about Soundcraft Magna-Stripe raw stock:

REEVES **SOUNDCRAFT** CORP.
Great Pasture Road, Danbury, Conn.
LOS ANGELES: 342 N. LA BREA AVENUE

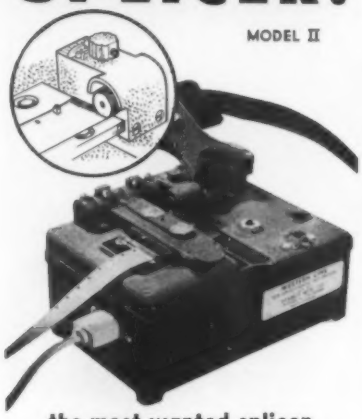
"THEY GO TOGETHER"



Write for complete information about Auricon Filmagnetic Cameras:

BACH AURICON Inc.
6998 Romaine St., Hollywood 38, Calif.
SOUND-ON-FILM EQUIPMENT SINCE 1931

"BUZZ OFF" EMULSION
WITH
WESTERN Cine
16MM AUTOMATIC
SPLICER!
MODEL II



the most wanted splicer
IN AMERICA

The all new Western Cine Automatic Splicer is the "hot" one to buy! It features an exclusive power driven rotary scraper that does all the work for you. It meets the most exacting requirements of the film industry; yet, it is so easy to operate that even the non-professional can make perfect splices every time . . . and in a few seconds! It's fully guaranteed. Get the details today!

SEE YOUR DEALER, OR WRITE

WESTERN Cine SERVICE Inc.
312 So. Pearl St. • Denver 9, Colo.

Equipments exhibited by Marconi's Wireless Telegraph Co. at the Second Industrial and Television Exhibition, held in London in November, included the Marconi-Siebe, Gorman underwater television camera. There was also a selection of closed-circuit television units and accessories. The underwater camera is designed to be handheld and can be buoyancy-adjusted for virtual weightlessness under water. Overall dimensions are 3 ft by 2 ft, 3 in. The closed-circuit equipment exhibited included a camera Type 4339A, lens turret, weatherproof housing and an industrial synchronizing generator.

Biographical Note

Fred E. Altman

Retirement of Fred E. Altman, Assistant Director of Optical Design for the Apparatus and Optical Division of Eastman Kodak Co., has been announced.

Widely known as an authority on optical design, he is a Fellow of the Society and his interests during his 45-year career with Kodak have been reflected in papers published in the *Journal*. He presently holds more than 40 U.S. Patents in the field of optical design. As early as 1934 he was engaged in the development of a lens for the "the so-called wide film . . . 70mm" ("A Revolving Lens for Panoramic Pictures," by F. Altman, *Jour. SMPE, 24:* 383–394, May 1935).

With the Kodak Lens Design Department during World War I, Mr. Altman was engaged in designing optics for gunsights and for the new field of aerial photography. During World War II, with the same department, he again worked on military optics, participating in the development of a telescopic tank sight in the short space of three weeks. Among Mr. Atlman's inventions and the developments on which he worked is the *f*/1.9 Cine lens which has been continuously manufactured for 35 years.

Other interests of Mr. Altman's described in *Journal* papers include "An Optical System for the Reproduction of Sound From 35mm Film (co-author, J. H. McLeod), *Jour., 31:* 36–45, July, 1938, and "35mm to 16mm Sound Reductions printer," (co-authors, C. W. Clutz and J. G. Streiffert) *Jour., 52:* 669–675, June 1949.

Mr. Altman's retirement plans include further studies in optics, and a number of recreational activities including golf, woodworking, mountain hiking and photography.

Abstracts

Abstracts from other Journals, chosen for importance and timeliness, are published in the *Journal* from time to time. The greater numbers of these abstracts are translations, chiefly from the U.S.S.R., and made available by the *Kodak Monthly Abstract Bulletin*

The subject areas are grouped below

High-Speed Photography and Instrumentation
Printing and Optics
Projection
Sensitometry and Image Structure
Sound Recording and Reproduction
Televison

HIGH-SPEED PHOTOGRAPHY AND INSTRUMENTATION

Light Sources and Shutters for High-Speed Photography and Cinematography. (in Russian), V. G. Pell', *Tekh. Kino i Televideniya, 4:* 79–86, June 1960.

Western developments in spark, flash and discharge lamps and in Kerr-cell, Faraday and other high-speed shutters are reviewed.—S.C.G.

New Flash Lamps (in Russian), I. S. Marshak, V. I. Vasil'ev, A. I. Mironova, V. P. Ivanov and R. G. Vdovchenko, *Uspekhi Nauch. Fotografii, 6:* 43–52, 1959.

The characteristics of a number of flash-discharge tubes now being produced in the Soviet Union are described, and an attempt is made to classify them.—S.C.G.

Physical Mechanism of the Discharge in Tubular Electronic Flashlamps and Their Loading Limits (in Russian), I. S. Marshak, *Uspekhi Nauch. Fotografii, 6:* 16–26, 1959.

An analysis is made of the conditions during the quasistationary state of the discharge in an electronic flashtube when a large current is flowing. The theory of the striking of the discharge by the application of the small, high-frequency pulse is discussed. Formulas are worked out for the limiting loads set by the incipient destruction of the glass or quartz envelope.—S.C.G.

Study of the Brightness of a Flash-Discharge Channel (in Russian), K. S. Vul'fson and F. A. Charnaya, *Uspekhi Nauch. Fotografii, 6:* 27–30, 1959.

The variation of the maximum brightness of the discharge in an electronic flashlamp filled with different gases, as the pressure and electrical parameters are varied, is studied experimentally.—S.C.G.

Spectral Characteristics of Electronic Flashtubes (in Russian), B. M. Vodovatov and M. I. Epshteĭn, *Uspekhi Nauch. Fotografii, 6:* 35–42, 1959.

The method of testing of a number of Soviet-produced electronic flashlamps is described. The relative spectral-energy densities of the lamps are tabulated, and, for one of the lamps, a table gives the variation of the relative spectral-energy

NEW!

SERIES 78 BATTERY-POWERED SYNCHRONOUS INVERTERS

provide a source of 115V A.C. 60 cycles for synchronous operation of equipment in the field. A 10 minute take made with cameras and film recorders driven from these Inverters will be in precise lip-sync ±¼ frame. 50 Watt thru 500 Watt models are available for driving all cameras, such as Mitchell, Arriflex, Auricon, etc. or any film recorders. All solid state, the unit pictured above, Type 78A, 50 Watts, weight 5 pounds.

SERIES 88 BATTERY-OPERATED SYNC TRACK GENERATORS for recording 60 cycles on ¼" tape. Used with Nagra, Perfectone, or other battery operated tape recorders. All solid-state, fits in jacket pocket, or outboard on recorder. Also, A.C. powered Type 87, for both 14KC and 60 cycle sync track, available. All new, Series 78 and 88 provide ***totally linkless*** Double-System synchronism on location.

TYPE 92B PLAYBACK SYNCHRONIZER FOR SYNCHRONIZATION OF ¼" TAPE IN PLAYBACK WITH SPROCKET DRIVEN FILM

Responsible for tape to film transfer? Check out this addition to the distinguished MTE line of synchronizing equipment. You'll find no other gives you all of the 92B's important benefits:

WIDE RANGE, can correct speed deviations of +20% to −20% from sync speed.

CONTINUOUS DISPLAY OF SYNC CONDITION so user knows exactly whether tape is in sync. Oscilloscope semi-circle pattern moving clockwise indicates tape speed fast, counter-clockwise indicates tape speed slow, semi-circle standing still indicates precise sync speed. In addition, Comparator-driven window dial registers % deviation from sync speed.

SYNC SIGNAL LEVEL IS INDICATED BY VU METER, an Attenuator provides for boosting weak signals 20 DB. Also a Volt Meter indicates voltage to capstan motor.

HAS MEMORY if sync signal is lost, tape runs at last sync-controlled speed.

ADVANCING OR RETARDING TAPE TO LIP-SYNCHRONISM with picture, when screening, is achieved with a Spinner Knob Framing Control.

VERSATILE REMOTE CONTROLS for operating tape recorder at the Synchronizer are incorporated.

FULLY AUTOMATIC. Choice of automatic speed control for sync transfer work or manual speed control for special effects, pitch change, trimming time spots, etc.

COMPACT. All solid state. Entire 92B unit mounts in 12¼" of rack space, weighs 38 lbs.

COMPATIBLE. Can be used with tape transports including Ampex 350, 351, 354, 300, 400 and others. Uses 60 cycles or 14KC control track supplied by MTE type 87, 88, or any other control track generators.

ECONOMICAL. High utility in film studios, music studios, in-plant film production facilities. Solid state reliability eliminates maintenance. **Only $1,920.00**

M.T.E. MAGNA-TECH ELECTRONIC CO. INC.
630 9TH AVE. N.Y. 36, N.Y.

density with different power supplies.—S.C.G.

Image Movement in Time Magnification With Image Compensation (in Russian), A. S. Dubovik, *Zhur. Nauch. i Priklad. Fotografii i Kinematografii, 5:* 209–217, No. 3, May–June 1960.

A mathematical analysis of image movement in time magnification with image compensation leads to the following conclusions: (1) The center of reflection of the scanning lens in systems with image compensation changes its position relative to the intermediate image in the time of exposure of one frame, leading to movement of the image. In choosing the general center of reflection (scanning), it is necessary to take into account the magnitude of image motion for different parts of the working angle of the camera. (2) Image shift in depth has no influence on the photographic quality of the picture. (3) The movement of the image on exposure of a frame is proportional to the speed of the camera lens and, to a large degree, is determined by the distance of the reflecting plane of the mirror from its axis of rotation. (4) Movement of the image for a given lens speed is proportional to the size of the intermediate image (size of the mirror). The present investigation makes it possible to take image movement into account in correctly choosing an optical system for constructing a high-speed camera with image compensation.—S.C.G. (Adapted from Author's Abstract.)

Camera RKS-1 for High-Speed Cinematography, S. M. Provornov and O. F. Grebennikov, *Instruments and Experimental Techniques* (transl. ed. of *Pribory i Tekh. Eksper.*), 961–964, No. 6, Nov.–Dec. 1959.

A high-speed, raster rotating-mirror Soviet camera, RKS-1, designed for research cinematography at a frequency of more than 10^3 frames/sec is described. Some of the motion-picture frames are reproduced. (Authors' Abstract.)

A Light Source for a High-Speed Motion-Picture Camera (in Russian), N. N. Ogurtsova and I. V. Podmoshenskiĭ, *Uspekhi Nauch. Fotografii, 6:* 58–61, 1959.

The light source described is a spark gap in which the spark is rendered more uniform by confining it in a channel of 2-mm diameter cut in a plate of Textolite (a resin-impregnated, laminated cloth). The power source is a bank of four capacitors and inductances. Current, voltage, light output, and spectral characteristics of the source have been recorded.—S.C.G.

Image-Converter Tubes for the Study of Ultrarapid Processes (in Russian), M. M. Butslov, *Uspekhi Nauch. Fotografii, 6:* 76–83, 1959.

Two Soviet-made impulse image-converters are described that are suitable for obtaining a series of frames of an ultrarapid event. They are the PIM-3 and the smaller PIM-4.—S.C.G.

High-Voltage Ceramic Condensers for Electronic Flash (in Russian), K. E. Medvedev, *Uspekhi Nauch. Fotografii, 6:* 75, 1959.

A Power-Supply Circuit for Electronic Flashlamps Under Conditions of Rapidly Repeated Flashing (in Russian), V. P. Ivanov, A. L. Vasserman, A. A. Bukareva and V. P. Zhil'tsov, *Uspekhi Nauch. Fotografii, 6:* 62–63, 1959.

Only a summary of the original paper is given. The general problem of the design of power-supply circuits for rapidly repeating flashlamps was discussed and individual circuits were described.—S.C.G.

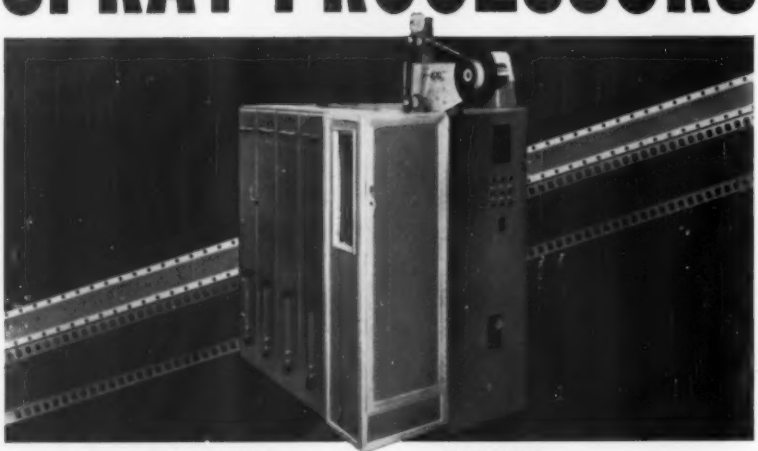
On the Use of Accumulators as a Power Supply for Flashlamps (in Russian), M. G. Feĭgenbaum, *Uspekhi Nauch. Fotografii, 6:* 64–67, 1959.

Two types of acid accumulator and one type of alkaline silver-zinc accumulator, both Soviet-made, were studied for use in the power pack of an electronic flashlamp, instead of the usual battery of condensers. The data obtained are tabulated.—S.C.G.

Electrolytic Condensers for Electronic Flash Equipment (in Russian), G. M. Gracheva, L. N. Zakgeĭm and V. F Safonov, *Uspekhi Nauch. Fotografii, 6:* 72–74, 1959.

Methods of Practical Preparation of Optical Grids for High-Speed Photog-

SOMETHING REVOLUTIONARY HAS HAPPENED TO SPRAY PROCESSORS



This is the new FA-50, Hi-Speed's new, compact spray developing machine for 16/35mm black and white film.

What makes it revolutionary?

Two things.

One — this is a spray process unit — that means it utilizes the processing technique most experts agree is better than any other . . . both in terms of film quality and uniformity.

Two — it costs less than half of what any spray machine has ever cost before.

Less than half.

What does that prove?

It means that first quality film results — really first quality results — are within reach of every film processor.

Would you like us to prove it? Let us send you complete technical and cost information. Write today.

FEATURES:

- Only 2 gallons of solution required
- Instantaneous results
- Professional quality
- 50 ft/minute positive — black and white
- 25 ft/minute negative — black and white
- Will process 16 mm and 35 mm, perforated and unperforated

hi-speed

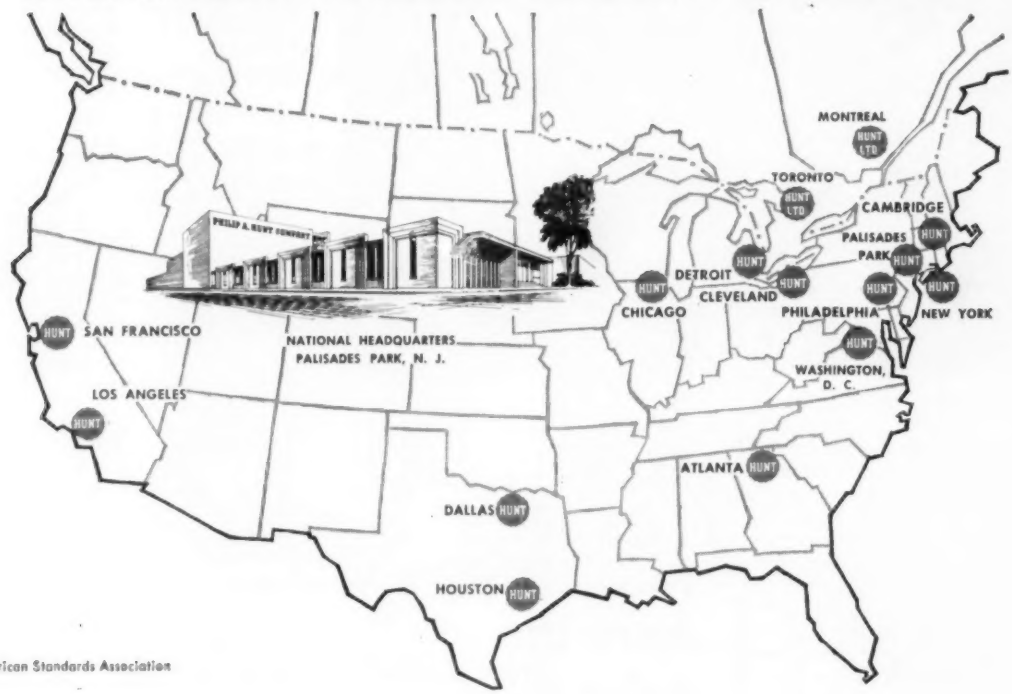
EQUIPMENT, INC.

76 Pond Street, Waltham 54, Mass.

Rapid Deliveries Into Your Mixing Room

HUNT ASA* SPECIFICATION GRADE PHOTOGRAPHIC CHEMICALS

Guaranteed FROM COAST TO COAST



*American Standards Association

WRITE, WIRE OR PHONE NEAREST HUNT OFFICE IN:

METROPOLITAN NEW YORK
Long Island City
47-20 30th Street
Telephone—EMpire 1-9500

PHILADELPHIA
401 North Broad Street
Telephone—MArket 7-3212

WASHINGTON
734—15th Street, N.W.
Telephone—EXecutive 3-3872

ATLANTA
1734 Candler Building
Telephone—MUrray 8-4944

CAMBRIDGE, MASS.
111 Binney Street
Telephone—TRowbridge 6-7050

CHICAGO
2108 West Fullerton Avenue
Telephone—HUmboldt 6-8500

CLEVELAND
5150 Grant Avenue
Telephone—Diamond 1-9132

DETROIT
Telephone—WAlnut 5-5130

LOS ANGELES
2252 East 37th Street
Telephone—LUdlow 2-8136

SAN FRANCISCO
420 Market Street
Telephone—YUkon 6-4761

DALLAS
2nd Unit, Sante Fe Building
Telephone—RIverside 8-2279

HOUSTON
Telephone—CApitol 2-2537

CANADA —
Philip A. Hunt Co. (Canada) Ltd.
Toronto
207 Queen's Quay West
Telephone—EMpire 3-5456
Montreal
Telephone—WEllington 2-3607

FOR SUPERIOR RESULTS AROUND THE CLOCK USE HUNT GRAPHIC ARTS CHEMICALS

PHILIP A. HUNT COMPANY

PALISADES PARK, NEW JERSEY

BRANCHES IN PRINCIPAL CITIES

In Canada: Philip A. Hunt Company (Canada) Ltd., 207 Queen's Quay West, Toronto

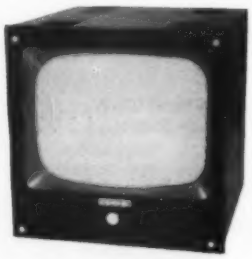
MANUFACTURING CHEMISTS HUNT ESTABLISHED 1909

In planning the new control room for their famous Stage 6, Paramount Television specified only the best equipment manufactured. Included in this choice, naturally, were Conrac video monitors. Why Conrac? "Because of their unfailing ability to display all the information just as it is, without distortion, and do it dependably day after day, after day," is the way John Silva put it. Whether you're building a new facility or expanding your present operation, it will pay you, too, to select Conrac – the finest in video monitoring equipment.

"For our new control room, CONRAC MONITORS were the natural choice..."

EVERY CONRAC MONITOR FROM 8" THROUGH 27" BROADCAST OR UTILITY *includes these important features:*

- ★ Video response flat to 10 megacycles
- ★ DC restorer – with "In-Out" switch
- ★ Provision for operation from external sync – with selector switch
- ★ Video line terminating resistor and switch



Conrac Monitors Are Distributed by – RCA GENERAL ELECTRIC AMPEX *and* VISUAL ELECTRONICS

CONRAC,® INC.

Makers of Fine Fleetwood Home Television Systems

Dept. K, Glendora, California

TELEPHONE: COVINA, CALIFORNIA, EDGEWOOD 5-0541

raphy, (in Russian), L. V. Akimakina, *Uspekhi Nauch. Fotografii, 6:* 152–154, 1959.

Optical grids decomposing an image into elements are required for a number of purposes, including high-speed cinematography and stereophotography. They may be made by mechanical methods involving casting or stamping from a metal matrix, or by photomechanical methods. A number of methods are briefly outlined. The paper is only a summary of the original lecture.—S.C.G.

A Raster Method of High-Speed Cinematography (in Russian), O. F. Grebennikov, *Uspekhi Nauch. Fotografii, 6:* 144–151, 1959.

The principles of image dissection in high-speed photography by means of a line or a point grid are outlined. The advantages of a point grid are discussed. Since 1954 a study has been made of the possibilities of using a point grid, consisting of a glass plate with an array of embossed spherical lenses, together with a system of rotating mirrors and a moving film. The necessary characteristics of such a camera required to give the maximum information content are analyzed in relation to the resolving power of the optical system and the photographic material.—S.C.G.

An Image-Converter Method of Photographing Ultrarapid Processes (in Russian), M. M. Butslov, E. K. Zavoĭskiĭ, A. G. Plakhov, G. E. Smolkin and S. D. Fanchenko, *Uspekhi Nauch. Fotografii, 6:* 84–89, 1959.

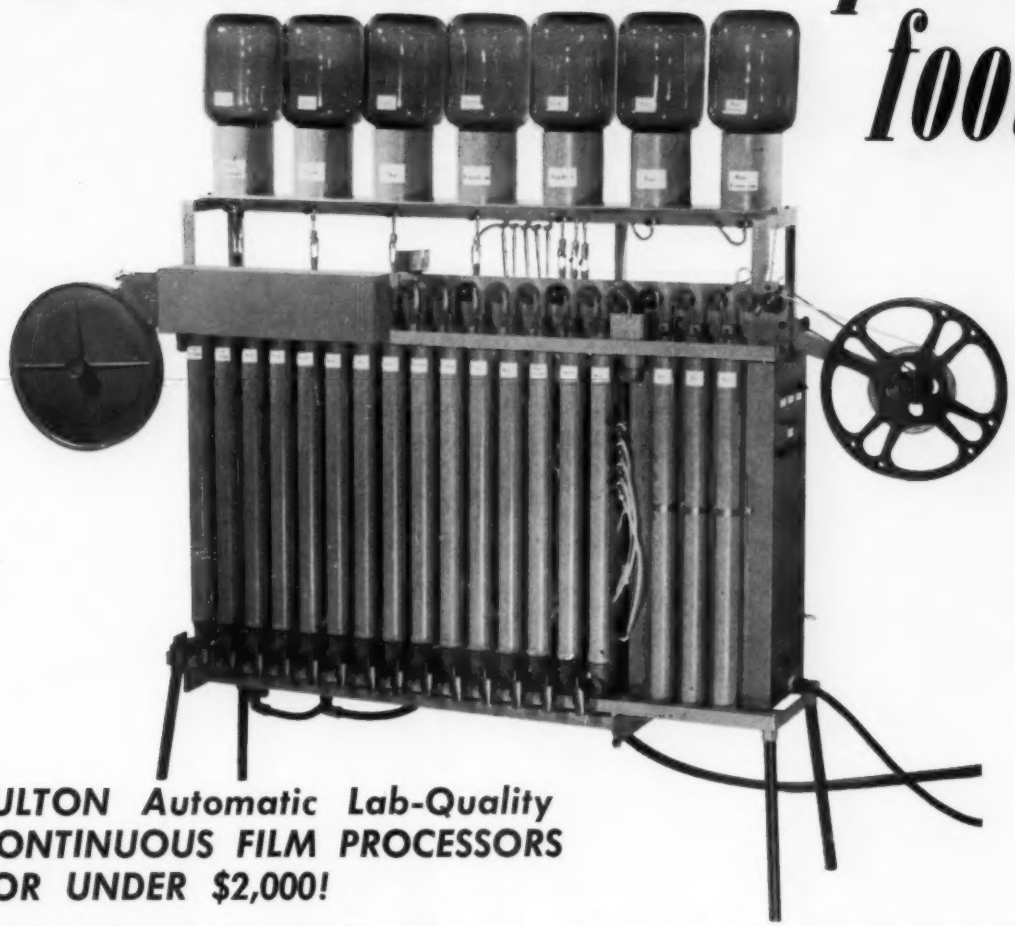
An image-converter tube is adapted for producing streak records of a small light source by introducing deflecting plates, as in the ordinary television tube. The applied deflecting voltages spread out the image into a circular arc. Time resolutions of the order of 10^{-12} sec can be obtained. Some experimental applications of such a tube are mentioned.—S.C.G.

PRINTING AND OPTICS

Study of the Change of Quality of a Photographic Image During Printing (in Russian), I. B. Blyumberg, T. M. Zyazina and G. I. Teregulov, *Tekh. Kino i Televideniya, 4:* 10–18, July 1960.

To study the photographic image during printing, a positive was obtained from an original negative with the insertion of two intermediate positives and two internegatives into the printing series. The quality of the image obtained at each stage was examined. With good contact during printing, the quality was independent of the use of diffuse or direct lighting. Poor contact was much more important when diffuse lighting was used than when the lighting was direct. During the printing series, picture sharpness did not fall as much as resolution. The graininess of a positive image obtained by printing was higher than the graininess of the negative if $\gamma_{pos} \gg 1.0$; and it was less if $\gamma_{pos} \ll 1.0$. There is a connection between the change in graininess on printing and changes in resolution and sharpness. The greater the fall in resolution and sharpness, the smaller will be the growth in graininess, and vice versa.—S.C.G.

LOWEST COST per foot



FULTON Automatic Lab-Quality CONTINUOUS FILM PROCESSORS FOR UNDER $2,000!

The new FULTON AUTOMATIC FILM PROCESSOR produces laboratory-quality film at lower cost than ever before available. Motion pictures, microfilm and roll-film are processed, in black-and-white and color, for less than 25c per 100 feet. From light-tight magazine to projector-ready film in an extremely short time.

It is now possible and **practical** for every industrial plant, TV news department, and other users of motion pictures or microfilm to have their own high-quality continuous processor.

Outstanding features of the FULTON processor include: 16 ounces of working solution per tank; automatic replenishment; water consumption 2 gallons per minute.

The FULTON processor is daylight operated, completely portable, operates from any 115 volt outlet, and uses ¾" garden hose for water and drain connections. **No installation costs!**

Models are available for negative, negative/positive, reversal, Ektachrome and Anscochrome, as well as all microfilm emulsions. They acecpt 16, 35, 70, 105, 16/35 or 35/70 films or film combinations.

Prices start as low as $1875 for the standard 16mm black-and-white reversal model.

Get the full story on the automatic **continuous processor** that you can own and operate for less money than ever previously possible.

FULTON productions, inc

Tulare, California

For complete descriptive literature and technical data address inquiries to:

Instrumentation Associates, Inc., 19458 Ventura Blvd., Tarzana, Calif., exclusive sales representatives.

Properties of a Single-Element Light Amplifier Using Sintered Cadmium Selenide Photoconductive Material

The use of photoconductive sintered cadmium selenide as the control element in a light amplifier offers the possibility of improved gain and speed of response. Such a single-element light amplifier has been made and tested. The results show that moderate gains with high output luminance are possible with speeds in a range suitable for moving pictures. Very high gains are possible if slow response can be tolerated.

Measurements were made over a range of operating frequencies and for various input levels. Data on rise time, decay time, and gain for tungsten-light input are given in curve form. From these curves the operating range and input-output light levels for useful picture reproduction can be determined.—F. H. Nicoll, *RCA Review*, *20:* 658–669, Dec. 1959.

Solid-State Image Intensifier Under Dynamic Operation

This paper describes the performance of photoconductor-electroluminescent-phosphor image intensifiers under dynamic conditions of operation. Both experimental data and theory are presented. The theory is based on some simplifying assumptions which allow easy analysis and permit an insight into the importance of the various parameters. The experimental data, however, confirm the applicability of the analysis. Some suggestions concerning the possible improvement of intensifier performance are made.—C. P. Hadley and R. W. Christensen, *RCA Review*, *20:* 670–681, Dec. 1959.

Solid-State Optoelectronics

A discussion of the harnessing of photoelectric and luminescent phenomena is preceded by a brief classification and explanation. This is followed by a description of optoelectronic modulators and amplifiers, i.e., devices which have mixed optical and electrical signal and power access. The technology of assembling image-transmitting, image-storing, and picture-reproducing panels from optoelectronic elements is reviewed.

The functioning of various optoelectronic logic nets and computer components is treated in detail. Finally, a synthesis of panel technology and logic circuitry into novel picture-processing panels and computer systems is proposed. The similarity between the organizational structure of such parallel processing systems and that of the neutron network of vertebrate retinas is pointed out.—E. E. Loebner, *RCA Review*, *20:* 715–743, Dec. 1959.

Optical Feedback Type Storage Light Intensifiers

Three designs of storage light intensifiers were evaluated by building samples. One design uses a Fotoform glass structure to support the photoconductor and electroluminor and to provide optical isolation of cells. Another uses a transparent (glass or plastic) multiple pedestal structure to provide light paths through the photoconductor and support the active materials. The photoconductor itself provides the optical isolation. The third design uses a flat glass plate as a support, the active materials and optical isolation being built up in layer fashion. Devices of the last type worked best. Typical operation provided optical trigger of 0.1 foot-candle second, half-hour storage and 0.1 second erasure in a 12 inch square panel with 250,000 storage cells. With suitable operating conditions, half-tone pictures could be displayed for one minute or longer.—H. O. Hook, *RCA Review*, *20:* 744–752, Dec. 1959

PROJECTION

The Conditions for Perception of Films in Theaters in Relation to the Future Development of New Types of Cinematography. (in Russian), V. G. Komar, *Tekh. Kino i Televideniya*, *4:* 28–37, June 1960.

Study of a 35mm Motion-Picture Projector with Optical Equalization of the Discontinuous Motion of the Film (in Russian), L. G. Tarasenko, *Tekh. Kino i Televideniya*, *4:* 40–47, July 1960.

Results are given of a study of one of the mechanisms of optical equalization of the discontinuous motion of the film in relation to picture quality (stability, sharpness, brightness and flicker). It is shown that this method of motion-picture projection has a number of important advantages over the existing form.—S.C.G. (Translation of Author's Abstract.)

OUR SERVICE & DEPENDABILITY KNOWN THE WORLD OVER

CAMART DUAL SOUND EDITOR MODEL SB-III

- Single & double system 16mm & 35mm optical or magnetic sound.
- Use with any 16mm motion picture viewer.
- Works from left to right or right to left. Dual Editor without viewer... $195.00

Zeiss Moviscop viewer.... 89.50

Special editor viewer combination..... 269.50

NEW DESIGN FILM BIN WITH RACK

- Rectangular construction, 30 x 24 x 12.
- Fits easily into corners.
- Vulcanized fiber with reinforced metal frame. complete Bin Rack - linen bag w/skids $45.25 w/wheels 51.75

CAMART CORE DISPENSERS

Keeps film cores handy at all times. Attach to work table or wall.

Easy to remove — easy to fill. All aluminum construction. Adjustable to 16mm and 35mm cores.

Sizes

Length 16"... $9.50

Length 24"... 11.50

Length 36"... 14.50

CAMART TIGHTWIND ADAPTER

- The only BALLBEARING tightwind adapter.
- Eliminates cinching or abrasions.
- Winds film evenly—no slipping.
- Fits any 16 or 35mm rewind. $34.95

the CAMERA MART inc.

1845 BROADWAY (at 60th St.) NEW YORK 23 • Plaza 7-0177 • Cable Cameramart

at Columbus Circle next to New York's new Coliseum

in the east . . . it's

MOVIELAB

for color* and black & white

MOVIELAB FILM LABORATORIES
MOVIELAB BUILDING, 619. W. 54th ST.
NEW YORK 19, N.Y. JUDSON 6-0360

*developing color negatives • additive color printing • reduction printing including A & B • color slide film processing • blowups • internegatives • Kodachrome scene-to-scene color balanced printing • Ektachrome developing and printing • registration printing • plus complete black and white facilities including cutting rooms, storage rooms and the finest screening facilities in the east.

A Universal Motion-Picture Projector (in Russian), *Tekh. Kino i Televideniya, 4:* 47–48, July 1960.

A brief description is given of the Type TKPU-1 projector, made in the Kinap factory of Odessa. It is intended for the screening of 35mm film with photographic soundtrack; 35mm film with anamorphic image, photographic soundtrack and four magnetic soundtracks; and 70mm film with six magnetic soundtracks.—S.C.G.

The Problem of Stereoscopic Motion-Picture Projection in Polarized Light (in Russian).

A method of stereoscopic motion-picture projection using polarized light and the technical means of carrying it out are described. The following problems are considered: polarizing light-filters; the screen for polarized projection; the stereo projector; polarizing spectacles; and future developments.—S.C.G.

[Translated from *Tekh. Kino i Televideniya*] A. I. Levington and V. S. Shchekochikhin. *Trudy Vsesoyuz. Nauch.-Issled. Kinofotoinst.*, pp. 108-21, No. 31, 1959.

Yellow-Flame, High-Intensity Carbons With a Current Intensity of 225 A

Results are given of an experimental investigation of the construction of a powerful lamp with yellow-flame carbons for the shooting of color films on stock balanced for a color temperature of 3300 °K.

The article considers the following problems: the requirements for new carbons; the chemical composition and geometrical variables of the carbon; characteristics of high-intensity yellow-flame carbons; and the spectral characteristics of high-intensity yellow-flame carbons. (S. C. G.)—[Translated from *Tekh. Kino i Televideniya*] T. V. Derbisher, L. F. Kabanova, and N. K. Zanina. *Trudy Vsesoyuz. Nauch.-Issled. Kinofotoinst.*, pp. 26–35, No. 30, 1959.

Scratches on film distract attention

The whole purpose of your films may be frustrated by damaged physical condition

Peerless Reconditioning

restores films to presentable condition and keeps them in service

PEERLESS 27 Years of Service to FILM

PEERLESS FILM PROCESSING CORPORATION
165 WEST 46th STREET, NEW YORK 36, NEW YORK
959 SEWARD STREET, HOLLYWOOD 38, CALIF.

SENSITOMETRY AND IMAGE STRUCTURE

Some Points in the Production of Sharp Screen Images on Filming Fast-Moving Subjects (in Russian), M. P. Dolukhanov, *Tekh. Kino i Televideniya, 4:* 77–78, June 1960.

The exposure time for one frame of motion-picture film required to give a sharp image of a moving object is calculated. The actual exposure time obtainable with an 8mm camera is longer than this, but the resulting lack of sharpness is not noticeable. An explanation of this phenomenon is given in terms of information theory. Although a single frame may appear unsharp, the succession of slightly different images reduces the ambiguity and an impression of sharpness is obtained.—S.C.G.

SOUND RECORDING AND REPRODUCTION

The Problem of the Quality of Stereophonic Sound in Motion-Picture Theaters (in Russian), B. F. Natarov, *Tekh. Kino i Televideniya, 4:* 45–48, June 1960.

Feedback as a Method of Correction of the Frequency Characteristics of Electromechanical Light Modulators (in Russian), Yu. G. Zarenin, *Tekh. Kino i Televideniya, 4:* 38–44, June 1960.

A Reading System "with Back Scanning" (in Russian), L. Belyaeva, *Kinomekhanik*, 42–44, Jan. 1960.

In the usual form of reading of a soundtrack in a motion-picture projector, called in the article "with forward scanning," the image of a mechanical slit is formed on the soundtrack and the light passing through is received on a photocell. In the system described, "with back scanning," an image of the soundtrack is formed on the mechanical slit and the light passing through is received on the photocell. It is claimed that, with this system, more even illumination can be obtained and adjustment is easier. It has been incorporated in the KSS-35 projector.—S.C.G.

The Number of Stereophonic Sound-Reproducing Channels in Wide-Format Cinematography (in Russian), B. F. Natarov, *Tekh. Kino i Televideniya, 4:* 49–51, July 1960.

The author describes his experiences with a five-channel stereophonic system with one soundtrack for sound effects.—S.C.G.

TELEVISION

New Measurements on the Transfer Properties of Objectives from the Standpoint of Television Techniques (in German), D. Frenzel, *Hausmitteilungen, Jos. Schneider and Co. Optische Werke, 12:* 64–72, 90–96 and 111–112, Nos. 5/6, 7/8 and 9/10, 1960.

A method of measuring the line spread of lenses is sketched in which the test

Announcing

BACH Auricon®

ALL-TRANSISTORIZED FILMAGNETIC®

RECORDING AMPLIFIER MODEL MA-11

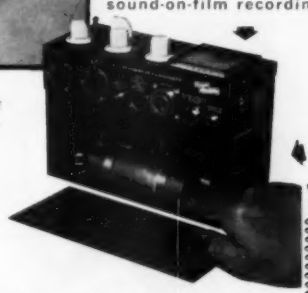
- ★ All-transistorized! Bulky batteries and heavy transformers eliminated.
- ★ Rechargeable battery or continuous A.C. operation.
- ★ 14 transistors for frequency response to 12,000 cycles.
- ★ Extreme portability and dependability. Weighs only 5 lbs.
- ★ Temperature-compensated for world-wide use, winter and summer.
- ★ Equipped with transistor-matched FILMAGNETIC heads.
- ★ Fitted carrying case can be conveniently stored under pullman seat or carried as hand-luggage on plane.

FILMAGNETIC DUPLEX A.C. POWER-PACK & CHARGER will fully charge MA-11 Amplifier Battery overnight. Plug into wall-socket . . . plug into Amplifier. It's that easy!

ALSO USED AS POWER-PACK for continuously operating Amplifier direct from 115 Volt A.C. current.

Permanent lightweight Battery can be re-charged repeatedly.

Fully charged Battery will operate Filmagnetic Model MA-11 Amplifier for more than 8 hours of sound-on-film recording.



★ WRITE FOR FREE AURICON CATALOG WITH INFORMATION ON THE NEW ALL-TRANSISTORIZED FILMAGNETIC RECORDING SYSTEM . . .

THIS IS THE FILMAGNETIC CAMERA UNIT for 16mm magnetic sound-on-film . . .

FILMAGNETIC sound-on-film recording can be factory installed on all existing, or earlier, Auricon Cameras. Recording on pre-stripe film, black-and-white **or color**, you get professional quality lip-sync talking pictures and brilliant music reproduction. After normal processing, the film can be shown on any 16mm magnetic-sound projector. In use since 1955, for exacting professional requirements, FILMAGNETIC, with the new MA-11 Amplifier, brings you the means for producing the finest in professional 16mm sound-on-film motion pictures. The **optical** sound-on-film capability of your Auricon Camera is not impaired. Change back and forth at will . . . without tools!

GUARANTEE

All Auricon Equipment is sold with a 30-day money back guarantee and a 1 year Service Warranty. You must be satisfied!

BACH Auricon

"FILMAGNETIC" SOUND FOR COLOR OR BLACK & WHITE

BACH AURICON, Inc.

6946 Romaine Street, Hollywood 38, California

HOLLYWOOD 2-0931

THE BACH Auricon LINE OF 16MM SOUND-ON-FILM CAMERAS

CINE VOICE II
100 ft. Runs 2¾ min.

AURICON "PRO-600 SPECIAL"
400 ft. Runs 11 min.

AURICON PRO-600
600 ft. Runs 16½ min.

AURICON SUPER-1200
1200 ft. Runs 33 min.

AURICON . . . THE PROFESSIONAL CAMERA · STANDARD OF THE 16MM SOUND INDUSTRY SINCE 1931

object is rotated, and a cathode-ray oscilloscope displays the attenuation curve as a function of frequency. Graphs for several lenses are shown in which the attenuation in decibels for a line interval of 0.7 mm is plotted against field angle.—F.H.P. (Reprinted from *Rundfunktech. Mitteilungen, 3:* 235–241, 1959.)

A High-grade Industrial Television Channel with Reference to Infra-red Operation

The range and scope of the uses of television for industrial purposes are indicated to give some of the design requirements and to show broadly how they have been met with reference to a particular television channel employing a vidicon camera tube. In addition, two special applications are described, namely the use of this channel with infra-red and ultra-violet light.—J. H. Taylor, *Jour. Brit I.R.E., 20:* 77–85, Jan. 1960.

The Equipment of the BBC Television Film Studios at Ealing

BBC film production facilities for the Television Service are based at the Television Film Studios, Ealing Green, London, W.5.

This monograph describes the operations which are involved and the facilities provided. Descriptions of the technical equipment and areas are included, together with some discussion on the differences between cinema film production methods and television film operations.—N. F. Chapman, BBC Engineering Div. Monograph No. 27, Jan. 1960: BBC Publications, 35 Marylebone High St., London, W.1.

Reduction of Television Bandwidth by Frequency-Interlace

A method analogous to the N.T.S.C. colour television system is used to obtain a bandwidth reduction of a black-and-white video signal by a factor of approximately 2:1. The normal signal is split into two frequency bands, nominally zero to 1.5 mc/s and 1.5 to 3.0 mc/s. The latter is used to amplitude-modulate a sub-carrier, whose frequency is an odd multiple of half the line scanning rate. The lower sideband of the modulator output is selected and combined with the original zero-to-1.5 mc/s band, so that the spectra of the two signals interleave. The combined signal may now be sent over a channel of 1.5 mc/s nominal bandwidth. At the receiving end of the channel the composite signal is applied to a synchronous demodulator, fed also with sub-carrier of the same frequency as at the transmitter. The lower sideband of this demodulator is taken and combined with the received signal, to yield a "normal" video signal extending from zero to approximately 3 mc/s, together with an "interleaved" signal. The interleaved signal is such as to give an interference pattern on the display which in a stationary picture should optically cancel after four successive frame scans. However, the pattern is built up in such a way as to give rise to a "crawling" motion which is very noticeable at close viewing distances. Photographs of typical pictures obtained with and experimental apparatus are given, showing various interference effects produced.—E. A. Howson and D. A. Bell, *Jour. Brit. I.R.E. 20:* 127–136, Feb. 1960.

Microwave Television Mobile Relay for Outside Broadcasting

A brief account is given of the principal qualities required in mobile links. These include transmission of picture and sound without degradation of the quality and stability in time of the technical performances, and ease of operation as regards transport, installation, monitoring and maintenance. The essential causes of distortion introduced in the transmission by a microwave link are reviewed and the problem of crosstalk between the picture and the sound channels and the transmission of a colour television programme are dealt with in some detail. A short description is given of an equipment operating in the band 6400–6900 mc/s.—J. Polonsky, *Jour. Brit. I.R.E. 20:* 91–102, Feb. 1960.

The Combined Television-Radio Receiver and its Problems

The large number of frequency allocations in and around Band II compared with Bands I and III causes a serious selectivity problem in domestic combined receivers for television and f.m. sound broadcasts. The sound bandwidth of a television receiver is usually of the order of 500–1000 kc/s and since the frequency allocations of commercial radio transmitters are liable to be

NAIL DOWN YOUR PROFITS!

Cameras: 16mm & 35mm—Sound (Single or Double System)—Silent —Hi-Speed

Lighting: Arcs—Incandescents —Spots—Floods—Dimmers— Reflectors—All Lighting Accessories

Generators: Portable—Truck Mounted

Sound Equipment: Magnetic— Optical—Mikes—Booms

Grip Equipment: Parallels— Goboes—Other Grip accessories

Cranes, Dollies: Crab—Western— Portable Panoram

Lenses: Wide angle—Zoom—Telephoto—Anamorphic

Editing Equipment: Moviolas —Viewers—Splicers—Rewinders

Projection Equipment: 16mm & 35mm—Sound & Silent—Slide— Continuous

Television: Closed Circuit TV

Camera Cars:

*CECO—Trademark of Camera Equipment CO.

RENT FROM CECO*

CAMERAS • LIGHTS ACCESSORIES

Why be equipment-rich, but profits poor? If *your* main concern is making money, investigate full-service leasing from CECO. Some of America's largest corporations have such arrangements with us. Renting your cameras, lights, sound recorders and accessories puts the problem of maintenance where it belongs—in the hands of factory-trained experts. Your accountant will explain the savings of renting versus buying. Want to talk about it? Call JUdson 6-1420. Today!

CAMERA EQUIPMENT CO., INC.
315 W. 43rd St., N. Y. 36, N. Y.
JUdson 6-1420
In Hialeah, Florida:
Camera Equipment Co., Inc. of Florida
1335 East 10th Ave • TUxedo 8-4604

Camera Equipment Co., Inc.
Dept. JS-15, 315 W. 43rd St., N. Y. 36, N. Y.
Gentlemen: Please rush me your FREE complete catalogue of Rental Equipment.

Name.....
Firm.....
Street.....
City.....Zone.....State.....

Magnasync-Magnaphonic

safari

mobile recording console

. . . a complete "sound truck" trailer!

SIDE VIEW

The "Safari" Console features the incomparable Magnasync Mark IX film transport and amplifier housed in a blimped console for both studio and mobile trailer operation. Three-channel mixer and recorder controls are packaged in removable remote unit. This elegant sound recording system is ruggedized and climatized, has plug-in audio elements and is completely self-contained with integrated power supply for cameras as well as the recording channel. Built-in "test lab" is provided for system performance testing.

These and many other outstanding features assure the producer of flawless recording under the most adverse conditions . . . with reliability as the keynote.

GENERAL SPECIFICATIONS

Frequency Response: 40 cps to 8500 cps ± 1.5 db (16 mm at 36 f.p.m.)
40 cps to 13,000 cps ± 1.5 db (17½ mm or 35 mm at 90 f.p.m.)

Distortion: Less than 1% total harmonic

Signal-to-Noise Ratio: Greater than 55 db

Flutter and Wow: 0.1% maximum RMS in any band
0.15% maximum RMS overall

Price: from $4,535.

Send for complete literature

MAGNASYNC
Magnaphonic SOUND SYSTEM

MAGNASYNC CORPORATION
formerly Magnasync Manufacturing Co., Ltd.
5548 Satsuma Avenue, North Hollywood, California • TRiangle 7-0965 • Cable "MAGNASYNC"
International leaders in the design and manufacture of quality magnetic recording systems

Magnasync Studio Equipment Division Dealers:

CHICAGO: Zenith Cinema Service, Inc.; Behrend Cine Corp.; **LOS ANGELES:** Birns & Sawyer Cine Equipment; **NEW YORK:** Camera Equipment Co.; **SOUTH AFRICA:** Johannesburg, Photo Agencies Pty. Ltd.; **AUSTRALIA:** Sydney, New South Wales, Sixteen Millimetre Australia Pty. Ltd.; **BOLIVIA:** La Paz, Casa Kavlin; **BRAZIL:** Rio De Janeiro, Mesbla, S.A.; **BURMA:** Rangoon, G. K. Theatre Supply Co., Ltd.; **CANADA:** Toronto, Ontario, Alex L. Clark, Ltd.; **DENMARK:** Copenhagen, Kinovox Electric Corp.; **ENGLAND:** London, W-1, Delane Lea Processes, Ltd.; **FRANCE:** Paris, Brockless-Simplex S.A.; **GREECE:** Athens, Christos Axarlis; **HONGKONG:** Supreme Trading Co.; **INDIA:** Bombay, Kine Engineers; **ITALY:** Rome, Reportfilm, di J. M. Schuller, S.R.L.; **JAPAN:** Tokyo, J. Osawa & Co., Ltd.; **NEW ZEALAND:** Auckland, Kerridge Odeon Industries; **PAKISTAN:** Karachi 3, Film Factors Ltd.; **SOUTH RHODESIA:** Salisbury, William Over & Co. Pvt. Ltd.; **THAILAND:** Bangkok, G. Simon Radio Co., Ltd.

Complete 16mm Laboratory

FAST QUALITY SERVICE

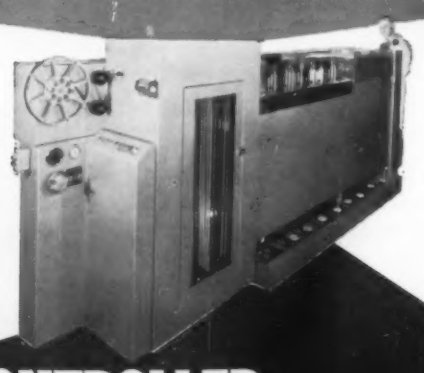
Negative or Reversal Processing
Color Duplicating
Black-and-White Duplicating
Editing
Sound Recording
Titling
Animation

Write for Price Schedules

Pan-American Films

735 POYDRAS STREET, NEW ORLEANS, LA., JACKSON 2-5364

Filmline THE
ULTIMATE IN
FILM PROCESSING MACHINES



CONTROLLED
PROCESSING
FOR ALL BLACK & WHITE...
AND COLOR EMULSIONS
FILMLINE CORPORATION, DEPT. JS-61, MILFORD, CONN.

within 500 kc/s of the BBC transmitters, interference can occur. Interference can also occur between the various BBC regional transmitters whose frequency separation is usually 400 kc/s, but may be as little as 200 kc/s. The problem and a number of different solutions are discussed in detail. The circuit details of a commercially available combined receiver are then described. The sound i.f. circuits incorporate a double superheterodyne system, and the frequency of its r.f. oscillator is stabilized in Band II by means of an inexpensive a.f.c. system. Methods are described for measuring accurately the selectivity of a Band II receiver.—R. S. Hildersley, *Jour. Brit. I.R.E., 20:* 155–166, Feb. 1960.

Automation of Television Programme Switching

The paper outlines a complete system under which nearly all the operations in programme switching are controlled by a punched paper tape derived directly from the preparation of the programme schedule. Simplified manual control facilities are provided for non-schedule operation. The term "Programmation has been coined to describe this field.—G. E. Partington, *Jour. Brit. I.R.E., 20:* 181–196, Mar. 1960.

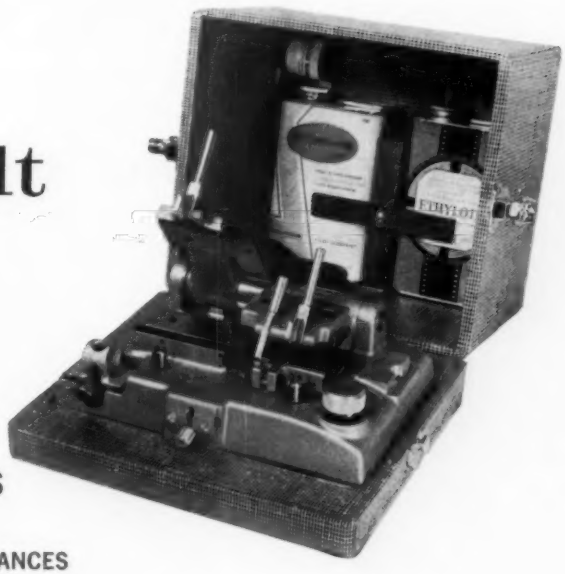
Waveform Distortion in Television Links

The linear transmission performance of television links is now measured and specified in terms of their response to certain standardized test waveforms. The aim of the paper is to provide a simple non-mathematical introduction to the basic ideas connected with the measurement of waveform distortion. A number of examples of simple waveform distortions are given to illustrate the advantages of waveform measurements and their connection with the more familiar steady-state responses. The application of tolerance limits to waveform responses is then considered and an outline is given of the routine-and-acceptance-test methods of determining the rating factor of a link. Finally a brief introduction is given to the basic ideas of the correction of waveform distortion without reference to the conventional steady-state measurement and equalization techniques.—I. F. Macdiarmid, *Jour. Brit. I.R.E., 20:* 201–216, Mar. 1960.

The Application of Closed-circuit Television in the Nuclear Industry

This paper reviews briefly the historical development of industrial television systems, and the applications of conventional equipment in the many branches of industry which depend upon nuclear processes. Special systems must be designed for use in the intense radiation fields and high ambient temperatures and pressures which occur in a nuclear reactor. The possible ambient conditions and their influences upon television camera design are discussed, with indications of the ways in which specific problems may be solved. An assessment of future trends suggests that television equipment will be called upon to operate in increasingly unfavourable environments; simultaneously, standard television systems will be used extensively for remote observation and display.—P. Barratt and I. M. Waters, *Jour. Brit. I.R.E., 20:* 225–241, Mar. 1960.

HFC
Hot Splicers
Now Available
in
Custom Built
Cases



NO DOWN TIME
WHEN YOU USE HFC SPLICERS

DOUBLE SCRAPING BLADES ON ALL UNITS
MACHINE BLADES GROUND TO CLOSE TOLERANCES
SEPARATE PROFESSIONAL SCRAPING BLOCK
NO DOWN TIME WHEN SCRAPING BLADES BECOME DULL
CHANGE BLADES IN SECONDS

SPECIAL OFFER!

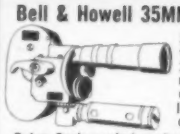
8 & 16MM	70MM	16-35/32-35MM
SPLICER (FS-816) $229.50	SPLICER (FS-70-1) (Military perf #1) or (FS-70-2) Military perf #2) $375.00	SPLICER (FSC-1) $329.50
CUSTOM BUILT CASE 15.00	CUSTOM BUILT CASE 20.00	CUSTOM BUILT CASE 17.00
1 PINT OF CEMENT 2.25	1 PINT OF CEMENT 2.25	1 PINT OF CEMENT 2.25
1 PINT OF ACETONE ..... .65	1 PINT OF ACETONE ..... .65	1 PINT OF ACETONE ..... .65
100 SCRAPING BLADES ... 44.00	100 SCRAPING BLADES ... 44.00	100 SCRAPING BLADES ... 44.00
TOTAL VALUE $291.40	TOTAL VALUE $441.90	TOTAL VALUE $393.40
SPECIAL $245.00	**SPECIAL $395.00**	**SPECIAL $349.50**

THIS OFFER EXPIRES MARCH 31, 1961

HOLLYWOOD FILM COMPANY 956 Seward, Hollywood, California, HO 2-3284 · 524 West 43rd St., New York LO 3-1546

GOV'T SURPLUS BARGAINS

Bell & Howell 35MM Camera—A6A



35mm movie camera, divergent 3 lens turret, 200 ft. mag., 28v. DC motor, used—in working cond. Accepts Eyemo lenses—double pulldown claw movement in mag.

Extra Spring wind motor, $55
Extra 1000 ft. magazine, $110

Only **$175**

B & H Eyemo 35MM Model 71-K Camera

With 2" lens, att. winding handle, w/ large deluxe case. Good cond. **$110**

LENSES IN EYEMO "C" MOUNT

1" T2.5 Baltar ctd. L.N.	$95.00
2" T2.5 Baltar ctd. L. N.	95.00
4" T2.5 Baltar ctd. L. N.	90.00
6" T4.6 Wollensak ctd. L. N.	80.00
10" T4.9 Miltar ctd. L. N.	80.00
4" F2.9 Cinemat ctd. L. N.	15.00
10" F4.5 Wollensak ctd. L. N.	40.00
10" Obj. View Finders	4.50
Ratchet Winding Cranks	9.00
Handle and Strap	2.00
400 ft. B & H Magazines	15.00
24v. Motors, as is	5.00

Cine Special 100 Ft. Mags.

NEW..... **$250** (list. $425)

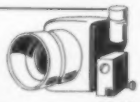
USED..... **$70** Good Cond.

K-38 Fairchild Aircraft Camera

with 24" f6.0 Bausch & Lomb Aero Tessar lens, 28v. motor. used, in working cond. **$65**

24" f6 lens only..... $45.00

K-24 Aircraft Camera



with 7" f2.5 Aero Ektar lens, 24v. motor, magazine. Used, in working cond. **$80**

7" f2.5 Aero Ektar lens only..... 55.00

Bell & Howell 16MM Editing Outfit

including Filmo 16mm viewer, pair large geared 2-speed rewinds, B & H 16mm splicer, rewind arms, custom built carrying case.

$95

2 Hub 16mm Neumade sync, w/ctr—NEW	$60.00
Mitchell 35mm Std. Tripod—Used	85.00
12 gal. stainless steel tank 13" x 6" x 47"—NEW	65.00
Recordak "A" Micro Film Proj. 16-35, case	70.00
GSAP—16mm mag. camera w/lens, NEW	18.00
GSAP—16mm mag. camera less lens	11.00

INTERCINEMA CORP.
P. O. Box 3452, New York 17, N. Y.

New Members

The following members have been added to the Society's rolls since the April 1960 *Directory* and those listed in the September and November *Journals*. Also listed are those regretfully reported as deceased since the September listing. The designations of grades are the same as those used in the Directory. An up-to-date list of the Sustaining Members appears on the outside back cover of each month's *Journal*.

Fellow (F) Active (M) Associate (A) Student (S)

Deceased

Fred J. DeJaeger (A) *Robert Duggan (A)* *Hal Huff (A)*
A. C Downes *Glen Glenn (M)* *Lloyd Thompson (F)*

Anerine, Peter J., Mot.-Pic. Cameraman, U.S. Naval Photographic Center, MPP Dept., Washington, D.C. (A)
Arakawa, Mitsuo, Eng., Far East Labs., Inc., 1-393 Gotanda, Shinagawa-Ku, Tokyo, Japan. (A)
Astradiningrat, R. Padma T., Studio Manager, Natonal Film Studios, Indonesia. Mail: Dept. of Cinema, Univ. So. Calif., University Pk., Los Angeles 7. (A)
Awad, Babiker Mohamed, Lab. Asst., Min. of Inform. & Labour, Sudan. Mail: Dept. of Cinema, University of Southern California, University Pk., Los Angeles 7. (A)

Beiser, Leo, Staff Eng., Tech. Prod. Div., Radio Receptor Co. Mail: 169-24 21 Rd., Flushing Manor 57, N.Y. (M)
Benwell, George D., Tech. Dir., CJCH-TV. Mail: 44 Springvale Ave., Armdale, Halifax County, N.S., Can. (M)
Biondo, G. A., Executive, International Recording, S.P.A. Mail: Via C. Balbo, 5, Rome, Italy. (M)
Blais, Allain, Sales Repr., Gevaert Co. Mail: 9627 Lockwood, Skokie, Ill. (A)
Blois, Donald R., TV Supvr., CJCH Ltd., 741 Robie St., Halifax, N.S., Can. (M)
Booth, Robert S., Mot.-Pic. Cameraman, U.S. Public Health Service. Mail: 1247 Lyle Pl., N.W., Atlanta 13, Ga. (A)
Brokaw, Edgar L., Producer, New York Studios, Inc., 354 W. 45 St., New York 36. (M)
Brown, A. J., Teacher, Radio & TV Trades, No. Sydney Tech. College. Mail: 26 Winifred Ave., Epping, N.S.W., Australia. (A)
Brown, Peter S., Miami Univ. Mail: 3622 S.W. 22 Terrace, Miami 45, Fla. (S)
Burt, William M., Dir., Film & Equip. Exch., U.S. Army, Valley Forge Gen. Hospital. Mail: Hares Hill Rd., Box 274, Kimberton, Pa. (A)
Buxbaum, Walter I., Supervising Film Editor, Dept. Health, Educ. & Welfare. Mail: 1170 Pine Ridge Rd., N.E., Atlanta 5, Ga. (A)

Cackowski, Stanley, Industrial Photo., IBM Co. Mail: 151 Cannon St., Poughkeepsie, N.Y. (A)
Cance, E. H., Tech. Mgr., Ancor Colourprint Laboratories, Ltd., Ormond House, Boswell St., London W.C. 2, Eng. (A)
Cavelli, Archie F., Quality Control, Movielab Film Labs. Mail: 1072 Hetfield Ave., Scotch Plains, N.J. (via Westfield P.O.) (A)
Chladek, James J., Pres., Crest Films. Mail: 3547 N. 14 St., Milwaukee 6, Wis. (M)
Coleman, Leonard F., Mot.-Pic. Eng., Eastman Kodak Co. Mail: 544 Countryside La., Webster, N.Y. (M)
Collier, Roger A., Sr. TV Techn., Columbia Broadcasting System. Mail: 217 Niagara St., Winnipeg, Manit., Can. (A)
Collins, Jacques Antoine, Film Cameraman, Canadian Broadcasting Corp. Mail: 390 Rielle, Apt. 17, Verdun 19, Que., Can. (A)
Colson, James Burton, Univ. Calif. L.A. Mail: 604½ Gayley Ave., Los Angeles 24. (S)
Crouch, Ernest Casimir, Chief Eng., Sound & TV Broadcasting, Country Broadcasting Services. Mail: 31 Lords Pl., Orange, N.S.W., Australia. (M)
Curtis, I. R., Techn., Canadian Marconi, CECF-TV. Mail: 72 Clermont Blvd., Laval des Rapide, Que., Can. (A)

de Brito, Robert F., Production Asst., Cinefonics-Cook Electric. Mail: Box 282, Skokie, Ill. (A)
Demetroules, Nick M., City Col. N.Y. Film Inst. Mail: 3458 30 St., Queens 6, N.Y. (S)
De Sanctis, Angelo, Mot.-Pic. Prod. Specialist, U.S.I.A. Mail: 367 E. 201 St., Bronx 58, N.Y. (A)
Dissman, James Harold, Univ. So. Calif. Mail: 808½ N. Verdugo Blvd., Glendale, Calif. (S)
Dolan, James E., Mot.-Pic. Elect., IATSE Local 52. Mail: 430 Center Ave., Westwood, N.J. (A)
Doust, John, Lab. Techn., Vice-Pres., Cinelaboratorios Caribe C.A., Prados del Este, Caracas, Venezuela. (M)
Ducklow, Robert C., Photo. Dept. Head, Valley Iron Works Corp. Mail: 510 E. North St., Appleton, Wis. (A)
Dudley, Leslie P., Stereoscopy Cons., Leslie P. Dudley, Inc. Mail: Westwood Glen Apts., Apt. 4, 10740 Wilshire Blvd., Los Angeles 24. (M)

Engle, Morris A., Photo. Supvr., The Martin Co. Mail: 366 Clermont Pkwy., Denver 20, Colo. (A)

Fisher, Meyer, Lab. Techn., Color Labs., Inc. Mail: 1146 S. Spaulding Ave., Los Angeles. (A)
Ford, Harry C., Studio Elect., Filmways, Inc. Mail: 50-08 Overbrook St., Douglaston 62, N.Y. (A)
Forsdale, Louis, Professor, Teachers College, Columbia University, 525 W. 120 St., New York 27. (A)
Forst, Donald J., Rochester Inst. Tech. Mail: 56 Chestnut St., Rochester 7, N.Y. (S)
Fulton, Mervin E., Pres., Fulton Productions, Inc. Mail: Box 980, Tulare, Calif. (M)

Gabo, Farouk Khalid Alla, Lab. Asst., Min. of Information & Labour, Sudan. Mail: Dept. of Cinema, University Southern California, University Park, Los Angeles 7. (A)
Gaffney, Donald Arthur, Rochester Inst. Tech. Mail: 13826 Clifford Ave., Cleveland 35, Ohio. (S)
Gellman, Ernest S., City Col. N.Y. Mail: 312 W. 48 St., New York 36. (S)
Gerisch, R. P., TV Eng., Columbia Broadcasting System. Mail: 2718 W. 166 St., Gardena, Calif. (A)
Goodman, Sheldon Alan, Indiana Univ. Mail: 619 N. Fess Ave., Bloomington, Ind. (S)
Goodson, Curtis C., Univ. So. Calif. Mail: 3658½ Glendon Ave., Los Angeles 34. (S)
Graham, George N., Sales Mgr., Kodak Processing Lab. Mail: 5604 Harwick Rd., Washington 16, D.C. (M)
Gray, Sanford D., Film Director-Prod., Instr., South Dakota State Univ. Mail: 222 N. Yale, Vermillion, S.D. (A)
Gubara, Gadalla Ibrahim, Film Producer, Information & Labour Ministry, Sudan. Mail: Dept. of Cinema, University Southern California University Park, Los Angeles 7. (M)

Haas, C. Harvey, Asst. Chief Eng., General Film Labs., 1546 N. Argyle, Hollywood 28. (A)
Harman, Fred C., Supvr., Telecine/Film Control Maint., CBS-TV. Mail: 360 Manor Rd., Douglaston 63, N.Y. (A)
Hayashi, James K., Electronic serviceman, 3255 Melemele Pl., Honolulu 14, Hawaii. (A)
Herring, Charles C., Chief, Bureau of Naval Weapons, Photo Div., Washington. Mail: 602 Meadow La., S.W., Vienna, Va. (A)
Herring, Kenneth George, Video Sales Supvr., Ampex Professional Products Co., 345 E. 48 St., New York 17. (A)
Hollis, W. B., Elect. Eng., Airtronics. Mail: 1338 Mission St., San Francisco, Calif. (A)
Holmes, Standish W., Editorial Publicity, Eastman Kodak Co. Mail: 134 Norcrest Dr., Rochester, N.Y. (A)
Horrall, Robert L., Rochester Inst. Tech. Mail: 95 Main St., W., Rochester 14, N.Y. (S)
Hughes, Jerry Glenn, Rochester Inst. Tech. Mail: Rm. 401, Men's Residence Hall, 95 Main St., W., Rochester 14, N.Y. (S)

Jacobsen, Theodore L., Sales Mgr., Westrex Corp., 6601 Romaine St., Hollywood. (M)
Jean, Yvon, Film Production Supvr., Canadian Broadcasting Corp. Mail: 5915 24th Rosemont Ave., Montreal, Que., Can. (M)
Jessen, Bruce Arnold, Iowa State Univ. Mail: 238 N. Hyland, Ames, Iowa. (S)
Johnson, F. M., Eng., American Broadcasting Company. Mail: 2805 Via San Delarro, Montebello, Calif. (A)

Kapilow, Marvin, Pres., Hudson Photo. Industries. Mail: 15 Wells Ave., Croton-on-Hudson, N.Y. (A)
Karr, Paul Spencer, Mot.-Pic. & TV Producer-Dir., Paul S. Karr, Prod; and KVOG-TV. Mail: 1250 E. First So., Salt Lake City 2, Utah. (M)

Spotlight on

Gevapan 30, Type 165 is favored by experienced cameramen all over the world. This film gives uniform results, even when the shooting schedule calls for both interior and exterior shots. The fine grain and excellent gradation give extremely good definition with excellent tone rendition. The special sensitivity of this film also minimizes make-up and other photographic problems.

Negative films
Duplicating films
Sound recording films
Positive films
Reversal films
Gevacolor films
Magnetic film

GEVAERT Offers a complete line of quality photographic materials

GEVAERT PHOTO-PRODUCTEN N.V., 27, SEPTESTRAAT, MORTSEL (ANTWERP) BELGIUM

In the U. S.: The Gevaert Company of America, Inc., 321 West 54 Street, New York 19

In Canada: Photo Importing Agencies Ltd., 345 Adelaide Street, West, Toronto 2B, Ontario

The ONLY Professional Meter...
measures ILLUMINATION, CONTRAST and BRIGHTNESS!
SPECTRA
HAND CALIBRATED FOR ABSOLUTE ACCURACY...
When thousands of dollars of narrow-latitude color film is shot, exposure must be "on the button." No wonder, therefore, that Hollywood's top cameramen and lighting technicians rely exclusively on SPECTRA! For this is the only meter in the world employing bench-matched components, with individually calibrated direct reading slides for every ASA film rating, present or future! Directly shows "f" stop, and foot candles, as well as brightness and contrast, even in unusually low light levels. If you're serious about photography, there is only SPECTRA! Complete with 14 slides, grid, disc, handsome fitted case. $97.50
Distrib. by Scopus, Inc., N.Y. 16, N.Y.
PHOTO RESEARCH CORP.
837 No. Cahuenga Blvd. Hollywood 38, Calif.

The ONLY meter that measures all light sources, including DAYLIGHT, accurately!

SPECTRA 3-color meter measures the proportionate amounts of all three primary colors present in the light source and indicates the filters necessary for positive color correction in Spectra Index Units. (°Kelvin conversion table supplied)

Write for descriptive literature and complete specifications.

PHOTO RESEARCH CORP.
Karl Freund, A.S.C., President
837 NO. CAHUENGA BLVD.
HOLLYWOOD 38, CALIFORNIA

Kaufman, Herbert S., Electr. Sales Eng., Airtronics. Mail: 1338 Mission St., San Francisco. (A)
Kimberly, Wilmer H., Mot.-Pic. Dir., U.S. Public Health Dept. Mail: 3445 Rockbridge Rd., R.D. 3, Stone Mountain, Ga. (M)
Kirkman, W. Royston, TV Maintenance Techn., CBC Radio Canada. 11832 General Giraud, Apt. 7, Cartierville, Que., Can. (A)

Lamb, Kenneth Franklyn, Univ. Miami. Mail: 27 Salamanca, Coral Gables, Fla. (S)
Landers, Albert R., Asst. to Pres., General Film Labs., 1546 N. Argyle Ave., Hollywood 28. (M)
Landre, John K., Eng., Zenith Radio Research Corp. 4040 Campbell Ave., Menlo Park, Calif. (A)
Leidig, Joseph Horner, Photo., Corinthian Broadcasting, WISH-TV. Mail: 3107 Falcon Dr., Indianapolis 24, Ind. (A)
Lencina, James F., Sound Recordist, N.Y. Studios, Inc. Mail: 28 Perry St., New York. (A)
Lethin, Jay E., Electr. Eng., Airborne Instrument Lab., Melville, N.Y. (A)
Lover, Anthony, City Col. N.Y. Inst. Film Technique. Mail: 20-66 35 St., Queens 5, N.Y. (S)

McAward, James C., Jr., TV Producer, William Esty Co. Mail: 47-12 245 St., Douglaston 62, N.Y. (A)
McDonnell, Jerry, Lt., USNR, Photo. Pilot. Mail: BOQ 600, Rm. A-321, Naval Air Sta., Pensacola, Fla. (A)
McDonough, John T., Film Editor, Bill Snyder Films. Mail: 1225 11½ St., N., Fargo, N.D. (A)
Matthews, Donald H., Free-lance Mot.-Pic. Sound-man, 30934 Florence, Garden City, Mich. (A)
Minturn, Paul A. L., Student, p/t Radio Eng., Dallas Theological Seminary Radio Dept. Mail: 3909 Swiss Ave., Dallas 4, Tex. (A)
Mitchell, Charles H., Chief Eng., KSBY-TV, KVEC Radio. Mail: 250 Highland Dr., San Luis Obispo, Calif. (A)
Montgomery, William E., Camera Oper., N.Y. Studios, Inc. Mail: 401 E. 50 St., New York 22. (A)
Montvid, Robert, Film Lab. Techn., Eagle Film Lab. Mail: 3852 W. 63 Pl., Chicago 29. (A)

Obeid, Ahmed, Asst. Film Prodtn. Officer, Sudan Gov't. Mail: Dept. of Cinema, University Southern California, University Park, Los Angeles 7. (M)
Osman, Abdel Karim, Cinema Centre Electr. Supt. Mail: Ministry of Information & Labour, Khartoum, Sudan. (M)

Pape, Leonard W., Closed-Circuit TV Eng., Chicago Communications Service. Mail: 4046 N. Whipple St., Chicago 18. (A)
Parks, Donald R., Control Dept., Associated Screen Industries. 2000 Northcliffe Ave., Montreal, Que., Can. (A)
Patel, Ramesh A., Dir., Patel India Pr. Ltd. Mail: Film Center, 68 Tardeo Rd., Bombay 7, India. (A)
Peak, Robert I., Printer Lab. Techn., Wilding Picture Prod. Mail: 1844 W. Irving Park Rd., Chicago 13. (A)
Polister, Richard C., General Mgr., George Ryan Films. Mail: 1741 Glenview Ave., Saint Paul 12, Minn. (A)
Pound, Earl F., Pres., The Cordin Co. Mail: 1356 Thornton Ave., Salt Lake City 5, Utah. (A)
Powers, Edward A., Optical Eng., Bausch & Lomb, Inc., 635 St. Paul St., Rochester, N.Y. (A)
Powles, Edward C., Tech. Dir., General Film Lab., Inc., 66 Sirley St., Detroit 1. (M)

Reddy, Chirra Ramalinga, Institute of Optics, University of Rochester, Rochester 20, N.Y. (S)
Rettig, Charles F., Commercial Pilot, Essex Wire Corp. Mail: 1819 N. Glendale Dr., Ft. Wayne, Ind. (A)
Ross, Louis, Radio, TV Eng., USIA. Mail: 6759 Julian St., Springfield, Va. (A)
Rudnick, B., Manager Photo. Dept., Republic Aviaton Corp. Mail: 89 Flower Hill Rd., Huntington, N.Y. (M)
Ryan, Frank D., Production Mgr., Cine Projectors, Bell & Howell Company. Mail: 7100 MacCormack Rd., Chicago 45. (A)

Sadler, Bill, Manager, Religious Film Productions. Mail: Box 2002, Tulsa 1, Okla. (M)
Scales, Bobby Ray, Univ. Calif. L.A. Mail: 1801 Centinela Ave., Santa Monica, Calif. (S)
Schatz Jack, Free-lance Mot.-Pic. Techn., 2115 E. 8 St., Brooklyn 23, N.Y. (A)
Schon, Christopher R. S., Photo., Stills & Spec. Cine-Effects, Canadian Marconi, CFCF-TV. Mail: 621 Prince Arthur, W.,#3, Montreal, Que., Can. (A)
Schramka, Bernard, Mot.-Pic. & Sound Techn., Bell & Howell Company. Mail: 4512 N. Harding Ave., Chicago 25. (A)
Shannon, Warren B., Special Effects, Filmways, Inc. Mail: 1179 Bushwick Ave., Brooklyn, 21, N.Y. (A)
Sisson, Waldo L., TV Eng., Times-Mirror Broadcasting, KTTV. Mail: 6123 Lexington, Apt. 6, Hollywood 38. (A)
Sopstyle, Walter J., Mot.-Pic. Photo., National Aeronautics & Space Administration. Mail: 101 W. Federal St., Snow Hill, Md. (A)
Sorio, George A., Newsreel Cameraman, Telenews. Mail: 7009 Larrlyn Dr., Springfield, Va. (A)
Standley, Arthur Clinton, Eng., Bausch & Lomb Optical Co., 635 St. Paul St., Rochester, N.Y. (A)
Steinberg, Alfred, Chief Instrumentation Eng., Republic Aviation Corp. Mail: 30 Dennis La., Bethpage, N.Y. (A)
Stellrecht, Karl, Camera Techn., U.S. Armed Forces. Mail: 2553 Malone Pl., Santa Clara, Calif. (A)
Swarthe, Eric, Managing Dir., Systems Technology Films. Mail: 455 E. 51 St., New York 22. (M)
Swerdlow, Donald Howard, Inst. Film Tech., City Col. N.Y. Mail: 915 Elsmere Pl., Bronx 60, N.Y. (S)

Takeuchi, Heihachiro, Instructor, Institute of Hi-Speed Mechanics, Tohoku University, Sendai, Japan. (A)
Theodore, Terry, Univ. So. Calif. Mail: 3200 S. Hoover Blvd., Los Angeles 7. (S)
Toler, William D., Photo. Mail: Box 2180, Research Center, Humble Oil Co., Houston, Tex. (A)
Tregillus, Leonard, Research Associate, Photo. Processing, Eastman Kodak Co. Mail: 297 Pinecrest Dr., Rochester 17, N.Y. (A)

Uragami, Stanley Ichiro, Univ. So. Calif. Mail: 3438 Fifth Ave., Los Angeles 18. (S)

West, Albert J., Jr., Producer Services Mgr., General Film Labs. 106 W. 14 St., Kansas City 5, Mo. (M)
White, Floyd E., Jr., Applications Elect. Eng., Scintilla Div., Bendix Corp. Mail: 1317-K Victory Blvd., Van Nuys, Calif. (A)
Wichelman, Ronald J., Rochester Inst. Tech. Mail: 14 Arlington St., Apt. 2, Rochester 7, N.Y. (S)
Wilhelm, Michael J., TV Tech. Dir., Univ. Detroit. Mail: 16852 Asbury Pk., Detroit 35. (A)
Williams, John Scott, Univ. So. Calif. Mail: 3133 Flower St., Huntington Park, Calif. (S)
Wystup, Zbigniew J., Mgr. Stand. Dept., FODU Mot.-Pic. Research Center. Mail: Warsaw 31, Nowolipki 21B m.23, Poland. (A)

Xander, Walter G., Mot.-Pic. Producer, Army Pict. Center. Mail: 420 Main Blvd., Allentown, Pa. (A)

Yarnes, Donald C., TV & Film Rec. Systems Eng., Radio Corp. of America. Mail: 3801 Woodcliff Rd., Sherman Oaks, Calif. (M)
Yavitz, Eric A., Eng., Eastman Kodak Co., Bldg. 35, Kodak Pk., Rochester 4, N.Y. (A)

Zielinski, Waleryan W., Supt. of Mfg., Bell & Howell Canada. Mail: 264 Calvington Dr., Downsview, Ont., Can. (M)

SMPTE Test Films

Test films planned by the Society's technical committees and produced under the Society's exact supervision are available from the headquarters office at 55 West 42 St., New York 36. A catalog containing brief descriptions of each film is obtainable on request.

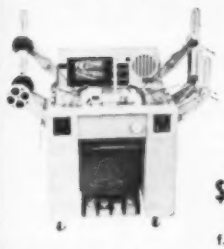
These films are used by manufacturers for testing the performance of new equipment, by television station technicians for lining up and adjusting film pickup systems, by maintenance men for "in service" maintenance of projectors and sound equipment, and by dealers for testing and demonstration equipment.

Films are available as follows:

Television — Picture Only, Color or Black-and-White
CinemaScope
Visual 35mm — Picture Only
Magnetic — 16mm Sound Only
Picture and Sound — 16mm
Picture Only — 16mm
Glass Slide — 16mm

F & B PARADE OF NEW PRODUCTS

ACMADE MARK II
EDITING TABLE



Makes Editing Easy!

Prices are in line—complete 2 channel unit

$2975

f.o.b. New York

Operation of this simple, efficient editing machine can be mastered in minutes. Continuous movement provides absolute safety for your film. Instant controls and declutching allows up to 50% increase speed and efficiency in editing. Any combination of 2 or 3, 16mm or 35mm channels, plus magnetic and optical sound available.

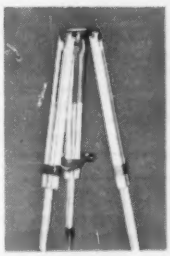
WRITE FOR DETAILED BROCHURE

NEW F & B MARK III FLUID DRIVE TRIPOD

Complete outfit for 16mm cameras, 35mm Eyemos & Arris, at an amazingly low price.

$139.50

Includes Tripod, Adapter and Visco-matic Fluid Head. With F & B's usual iron-clad guarantee.

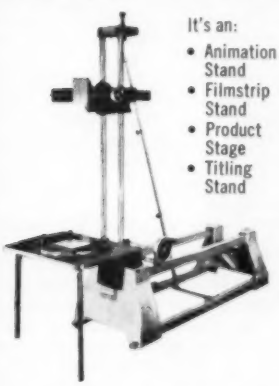


The day of the friction head is fast coming to an end. More cameramen now use fluid drive heads **because** they meet the demand for smooth, continuous, easily-controlled action.

Tripod legs only	$49.50
Baby tripod legs only	47.50
Fluid Head only	97.50
Leather & Vinyl case	12.50
Leather & Vinyl case for Baby	11.50

F & B Triplex ANIMATION STAND

The undisputed performance champion in the low-priced animation stand field.



It's an:

- Animation Stand
- Filmstrip Stand
- Product Stage
- Titling Stand

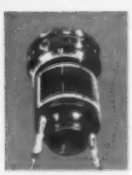
Compare these specifications:

- Zoom Range 1-30 Field
- Compound Camera Carriage 18" E-W, 12" N S
- Tracking Accurate to 1/1000 of an inch

Weight 450 lbs. 14 Accessories Available

Basic Stand **$995**

DIRECTORS' VIEWFINDERS

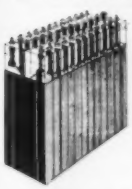


New, imported director's viewfinder with large, clear optics in 4 new models at very reasonable prices.

Model I—for 35mm, range 25mm-135mm	$49.50
Model IA—for 16mm, range 11.5mm-75mm	49.50
Model IB—for 16 mm, range 8mm-75mm	69.50
Model III—for 35mm Wide-Screen & TV Camera range 3-4 to 2.55-1, with sliding, adjustable marks	89.50

FREE —Neckchain and Leather Case with Order **!**

F & B NICKEL CADMIUM BATTERIES



The perfect companion for your Arriflex, mounted in rugged aluminum case, with shoulder strap. Indestructible, high capacity Nickel Cadmium cells provide perfect power, absolutely guaranteed for 1 year.

7v. Battery (6 cells)	$85.00
10v. Battery (8 cells)	100.00
15v. Battery (12 cells)	135.00
Voltmeter attach. (opt)	20.00
Ammeter attach. (opt)	10.00
Miniaturized Charger	29.50
NEW—15v-7½v Battery—can be switched for 7½v or 15v for both 16mm and 35mm Arris	$155.00
With Built-in Charger	184.50

PORTMAN ANIMATION STAND

Our new streamlined design incorporates all the versatility of stands costing twice as much. Enthusiastic users from Australia to Venezuela endorse its rugged simplicity and efficiency.

More than 45 accessories available including:

- Multi-Plane Table
- Traverse Peg Bar
- 12 Field Crawl Unit
- Aerial Image Projector
- Stop Motor Motor
- Acme Portman Rack-over, 16mm-35mm Camera

Basic Stand **$1595**

WRITE FOR COMPLETE 20 PAGE CATALOG

SERVING THE WORLD'S FINEST FILM MAKERS

FLORMAN & BABB, INC.

68 West 45th Street, New York 36, New York · MUrray Hill 2-2928

Professional Services

TIME LAPSE — HIGH SPEED
SCIENCE MOTION PICTURES
Bacteriology, chemistry, scientific special effects applied to motion pictures and TV
Consultation and production since 1929
THE BERGMAN ASSOCIATES
732 Eastern Parkway, Brooklyn 13, N. Y.
SLocum 6-0434

COLORTRAN CONVERTER
LIGHTING EQUIPMENT
The most illumination for the least investment
CROSS COUNTRY RENTAL SYSTEM
ELIMINATES COSTLY SHIPPING
write for catalog
NATURAL LIGHTING CORP.
630 S. Flower St., Burbank, Calif.

IN THE SOUTHWEST
For Equipment and Stage Rental
Technical and Creative Personnel
Complete 16mm and 35mm
Laboratory and Producer Services
It's BIG "D" FILM LABORATORY, Inc.
4215 Gaston Plaza, Dallas 10, Texas.
TAylor 7-5411 I.A.T.S.E.

TUFF COAT
Multiplies the useful life of all types of preprint and release film. Protects from scratches and abrasions. Safe, easy to use. Kills static, cleans and lubricates. Special type available for Videotape, Magstripe and Lacquered footage.
Send for Brochure "S"
NICHOLSON PRODUCTS CO.
3403 Cahuenga Blvd. Los Angeles 28, Calif.
Ho. 7-1712

BERTIL I. CARLSON
Photoproducts Co.
Consultants, designers, builders in PHOTO INSTRUMENTATION
Box 60, Fort Lee, N. J.

SAVE 25-50% ON PRINT COSTS
Users of Permafilm Protection and Perma-New Scratch Removal show savings ranging from 25% to 50% and more by lengthening the life of their prints. A money-back test will convince you.
PERMAFILM INCORPORATED
723 7th Ave.-New York 19-CI 6-6130
PERMAFILM INC. OF CALIFORNIA
7264 Melrose Avenue
Hollywood Webster 3-8245

CRITERION
FILM LABORATORIES, INC.
Complete laboratory facilities for 16 & 35mm black-and-white and color
33 West 60th St., New York 23, N. Y.
Phone: COlumbus 5-2180

PHOTOGRAPHIC INSTRUMENTATION
Specializing in
HIGH-SPEED
Motion-Picture Photography
Photographic Analysis Company
100 Rock Hill Rd., Clifton, N. J.
Phone: Prescott 9-4100

ELLIS W. D'ARCY & ASSOCIATES
Consulting and Development Engineers
8mm Magnetic Sound Printers
Motion-Picture Projection
Magnetic Recording and Reproduction
Box 1103, Ogden Danse, Gary, Ind.
Phone: Twin Oaks 5-4201

SUPPLIERS
PHOTOGRAPHIC CHEMICALS
and
Consultants in Photographic Chemistry
L. B. Russell Chemicals, Inc.
14-33 Thirty-First Avenue
Long Island City 6, New York
RAvenswood 1-8900

16mm SOUND
Modern Sound Recording Studio
Narration Recording
Magnetic & Optical Rerecording & Mixes
Music-Effects Library
FISCHER PHOTOGRAPHIC LABORATORY, INC.
6555 North Ave., Oak Park, Ill., EUclid 6-6603

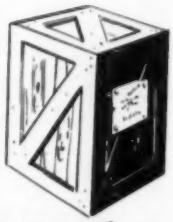
FILM PRODUCTION EQUIP.
SALES
LEASING
SERVICE
World's largest source—practically every need for producing, processing, recording, editing motion picture films.
S.O.S CINEMA SUPPLY CORP.
New York City: 602 West 52nd Street, PLaza 7-0440
Hollywood, Calif.: 6331 Hollywood Blvd., HO 7-2124

RENT
16mm, 35mm, 70mm
Motion Picture Cameras
High Speed Cameras
Special Cameras
Lenses
Lights
Processing Equipment
Editing Equipment
GORDON ENTERPRISES
5362 N. Cahuenga, North Hollywood, Calif.

ALL 16mm PRODUCERS SERVICES
Equip. Rentals • Technical Crews
40 × 70 Sound Stage
16mm LABORATORY FACILITIES
Exclusive TRIAD Color Control
Additive Color Print Process, Plus B & W
SOUTHWEST FILM CENTER
3024 Ft. Worth Ave., Dallas 11, Texas

IN THE CENTER OF THE U. S.
8mm ● OVERNIGHT
16mm ● BLACK & WHITE PROCESSING
HAROLD'S FILM SERVICE
Box 929—Sioux Falls, South Dakota

16mm CENTRAL PROCESSING SERVICE
Anscochrome Ektachrome ER
Reversal—Negative—Positive
Printing—Recording—Rental—Editing
WESTERN CINE SERVICE, INC.
114 E. 8th Ave., Denver 3, Colo. AMherst 6-3061



new products (and developments)

Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.

A continuously operating optical maser which generates a coherent beam of infrared light has been developed by Bell Telephone Laboratories. The device uses a mixture of helium and neon gases for its active medium. It receives its energy from a low-powered (tens of watts) electrical discharge within the gas, and has an output power of about 1/100 w. Lying in the infrared portion of the spectrum, the beam of coherent radiation is highly directional, having a spread less than one minute of arc. Theoretically, a beam sent to the moon would cover a spot less than one mile in diameter.

The device is potentially capable of carrying vast numbers of telephone calls and television programs. It may also be used in various fields of research, especially in the study of the atom and its structure.

In operation, an electrical discharge flows through the mixture of helium and neon gases. The energy from the internal discharge excites the helium atoms to a very high upper metastable energy level from which they normally would not radiate energy. The neon atoms in the mixture collide with the excited helium atoms, and the energy is transferred to them through the collision process. The neon atoms themselves can then be stimulated to radiate their energy on demand in a continuous stream. The beam, reflected back and forth through the length of the gas-filled tube by semireflecting end plates, grows in intensity with each trip. Some of the beam is transmitted through the plates to form a very narrow output beam of coherent infrared light. During this stimulated radiation of energy, some of the neon atoms also drop into still lower energy levels, spontaneously emitting the reddish-yellow light typically associated with normal neon tubes A-

Of the fifteen 1960 Industrial Film Awards,* **ten went to films shot with Arriflex 16mm and 35mm cameras**...a record unmatched by any other camera! A record approached only by Arriflex's winner-majority showing last year.

Why Arriflex? Simply because the Arriflex does the job better and more easily, faster and more economically! You ought to try one of these world-famous motion picture cameras soon.

*ANNUAL INDUSTRIAL FILM AWARDS-conducted by the publishers of Industrial Photography magazine.

FOR LITERATURE OR DEMONSTRATION OF ARRIFLEX 16 AND ARRIFLEX 35MM CAMERAS, WRITE TO:

ARRIFLEX CORPORATION OF AMERICA

257 PARK AVENUE SOUTH, NEW YORK 10, N.Y.

WEST COAST: 826 NORTH COLE AVENUE, HOLLYWOOD 38, CALIF.

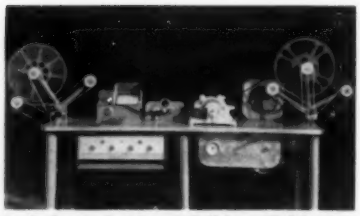
number of possible applications have been suggested including the accurate measurement of distances of many miles.

A booklet available without charge from H. W. Mattson, Bell Telephone Laboratories, Murray Hill, N.J., contains a detailed description of the optical maser at each stage of development.

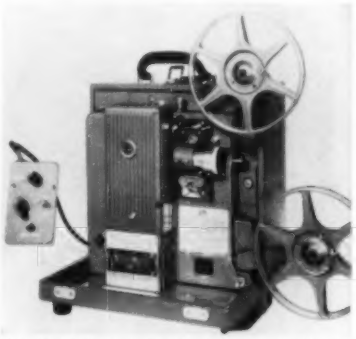
An optical maser, called a laser (from Light Amplification by Stimulated Emission of Radiation) has been developed in the laboratories of Hughes Aircraft Co., Culver City, Calif. The laser is constructed around a synthetic ruby crystal which is irradiated by a light source, such as a powerful flashtube lamp. The optical energy excites the atoms to a higher energy state from which the energy is reradiated in a narrow band of frequencies. The excited atoms are coupled to an atomic resonator and stimulated to emit the radiation together. According to the inventor, Theodore H. Maiman, the laser generates an almost perfectly parallel beam which, theoretically, could be directed at the moon, illuminating a lunar area less than 10 miles wide. The laser emits a sharp coherent light beam in the extremely high frequencies of optics — about 500,000 billion cycles/sec — where electromagnetic waves become light. Possible applications suggested by Dr. Maiman included use of the concentration of light energy to vaporize individual parts of bacteria, small plants and particles. It was also suggested that laser beam's light and heat could be used to induce chemical or metallurgical changes in biological, medical or industrial applications.

Experiments with ruby rods in the construction of optical masers are presently being conducted at Bell Telephone Laboratories.

An improved transistorized Filmagnetic sound recording system for use in Auricon cameras has been announced by Bach Auricon, Inc., 6950 Romaine St., Hollywood 38. The new Model MA-11 amplifier weighs only 5 lb and is designed for portability and dependability. The circuitry employs 14 transistors for amplifier frequency response to 12,000 cycles. New impedance matching techniques are used to eliminate heavy output transformers. The amplifier operates from a self-contained permanent rechargeable battery, or directly from 115-v house current for continuous operation. Three inputs (two microphone and one phono), with switch-operated compensation for speech or music, operate in conjunction with a visual recording-level indicator, with three individual input controls. Prices begin at $960.



A 3-channel 16mm Editing Table has been announced by Palmer Editors, 73-40 Vleigh Place, Flushing 67, N.Y. The unit is power driven by a reversible synchronous motor. Two speeds are provided through a belt shift — sound speed for normal viewing and high speed for quick inspection. Instant stopping is provided for. The drive is through timing belts and a clutch is provided so that the film can be moved by hand in either direction. For convenience in operation, the sound slit is 26 frames away from the synchronizer index and the picture aperture is 60 frames from it.



The L-W Photo-Optical Data Analyzer is a 16mm projector designed for data reduction of instrumentation film. The Analyzer is produced by L-W Photo Products Co., P.O. Box 147, Northridge, Calif. Variable-speed viewing from "still" to 24 frames/sec is reported to be accomplished without flicker. Remote control of all operating speeds permits pushbutton single-frame projection as well as automatic projection at previously selected speeds. Direction change to forward or reverse may also be remotely controlled. The machine also incorporates a daylight viewer. The unit is 12½ in. long, 14¼ in. high and 10¾ in. wide. It weighs 26 lb.

A 35,000-w VHF high-channel amplifier, said to have a driving power requirement of less than 5000 w has been developed by General Electric Co's Technical Products Operation, Communication Products Dept., Lynchburg, Va. Outlined in the announcement were such features as d-c filaments for improved signal-to-noise ratio; a triplex cavity with three parallel tubes; double-stub loading control to permit the exact degree of output loading required by the amplifier; and a built-in electronic r-f sweep generator to simplify tuning. The amplifier incorporates a semiconductor bias power supply which is basically a three-phase bridge circuit, the output of which is filtered for reduction of the 360-cycle component. Both the aural and visual amplifiers use a common power supply. The aural bias has self-bias adjustable resistors in each grid feed.

Off-The-Shelf Delivery!
IMAGE-ORTHICON, VIDICON LENSES
Rent or Buy Image Orthicon Lenses from World's Greatest Selection . . . choose from 28mm focal length to 60" . . . delivered right "Off-The-Shelf" at B & J World's Lens Headquarters!
Here you'll find the lens you need for practically ALL T.V. Cameras, R.C.A. (TK—41, TK—11); G. E. Black and white or color; Du Mont, etc.! Rely on the Industry's Prime Optics-Source . . . Pioneers in T.V. Optics Since 1936 and currently serving such stations as WGN, WNBQ, ETC.
Our Instrument Shops and "Know-how" offer you Special Mountings, Calibration and Custom Fittings! (Also Cine & Slide Equipment for your News Dept.!)
Write for New T.V. Optics Catalog.
BURKE & JAMES, INC. 321 S. Wabash, Chicago 4, Ill.

A six-camera closed-circuit television system built by General Electric Co. has been installed at Cape Canaveral so that missile launching can be observed by personnel stationed in a blockhouse at a distance of 1000 ft from the launching pad. One of the cameras is mounted directly over the flame bucket. This camera watches the proceedings during the four seconds between engine firing and missile launching. If a defect or malfunction is apparent to the observers in the blockhouse, the test can be halted in time to save the missile. One camera is mounted on the blockhouse to observe the missile during launching and in flight. The others are placed around the launching pad. The cameras are operated from a control console in the blockhouse and a permanent film record of the launchings is maintained.

The RCA Bi-Directional Distribution Systems, developed by Radio Corp. of America primarily for closed-circuit educational television, makes it possible to send signals in two directions simultaneously over the entire cable system without the use of parallel cable runs or switching methods. Each outlet on the distribution system serves a dual function. When a standard receiver is connected to the outlet, all r-f signals on the system can be seen. R-F signals fed into the outlet are then available at all other outlets. The output of the program originating equipment is in the form of a standard r-f TV signal. Off-the-air signals are fed into the main amplifier, are amplified, then passed through the mixer, distribution transformer and down the risers to the receivers. The signals from the closed-circuit program originating equipment are fed into the room outlet, go up the riser, pass through the distribution transformer and into the mixer. The mixer removes the r-f camera signal channel and feeds it to the convertor where it is converted to another channel. The converted signal is fed into the amplifier where it is mixed with off-the-air signals and fed out over the system. The output of the camera equipment is fed to a video modulator that provides an r-f signal. The output frequency may be a standard TV channel or below the standard VHF channels. In this way, only one channel is required for distribution. The camera channel is returned to the system amplifier so that proper operating levels can be established.

The system is based on a special "hybrid" distribution performer. Using this device, signals fed into the input will appear at any of the outputs, and signals fed into an output will appear at the input but not at the other outputs.

The Amphicon 108, announced by Dalto Electronics Corp., Oak St., Norwood, N.J., is a portable TV projector which projects an image of up to 9 by 12-ft on a motion-picture screen or a wall. The design is based on a flat-faced direct projection video tube. At a distance of 16 ft from the screen it projects a 9 by 12-ft picture. As the projection head is moved closer to the screen, the picture becomes smaller. The unit, which is self-contained, includes high-fidelity audio. It uses any type of antenna and operates on standard house current. The projection head may be separated from the tuning control, and the sound unit may be used in conjunction with existing sound systems. The complete unit weighs 95 lb.

The Zoomar Mark VI remote controlled ITV Lens has been announced by Zoomar, Inc., 55 Sea Cliff Ave., Glen Cove, L.I., N.Y., as audio and r-f noiseless due to the use of a newly developed miniature d-c motor designed to eliminate noise and electrical interference. Principle features of the new design are a novel copper armature, a miniature commutator made of five white gold wires, and spring-loaded brushes of the same material to assure spark-free contact. The entire armature is sealed with a plastic cover which prevents dust from entering and also renders it explosion-proof. The new lens, priced at $1350, is in full production and experiments, leading to the application of the same principle to the Mark IV lens are being conducted.

The firm has also announced availability of five conversion lenses for use with its Zoomar Service Collimator when a finite, rather than an infinite, target is desirable. An internal holder accepts conversion lenses which move the test target into a finite position. Target distances are 500 yd, 1000 yd, 2000 yd, 4000 yd and 8000 yd. The collimator with the five lenses is priced at $5500 with Standard Air Force Target. Lenses for any desired distance are available on special order.

CLASSIFIED ADVERTISING

First 3 lines $5.00
Each additional line $1.00
per inch $13.00

Bell & Howell gauges for Filmo repair & service.
Gauge #S-4163-N1 for aperature alignment
Price $282.25
Gauge #S-3973-N1 for shuttle teeth
Price $ 59.37
From Surplus new and unused
Both for only $150.00
Quantities limited—ACT NOW
Intercinema Corp., Box 3452, New York 17, N.Y.

FOR SALE: Cine Kodak Special Camera, with f 1.4 Ektar lens, reflex finder, optical finder, carrying case, 15 mm lens, 63 mm lens, 152 mm lens. All in excellent condition. Will sell all for $1200. Lawrence Beck, Beck Photo Shop, 5740 Rising Sun Ave., Philadelphia 20, Pa. Pilgrim 5-5990.

Achromat lenses providing high resolution in the 8–14 micron range are now being manufactured by the Servo Corp. of America, 111 New South Road, Hicksville, L.I., N.Y. These are in addition to achromats for 1–6 micron applications, according to a recent announcement. The firm has also announced a new computer program in its Optical Laboratory. The new program is expected to advance design and manufacturing operations in the production of Servacon lenses. The firm specializes in the manufacture of all types of infrared lenses and optical devices.

★ SPEEDS TO 20 FT. PER MIN.
★ DAYLIGHT LOADING
★ COMPLETELY AUTOMATIC
★ VARIABLE SPEED DRIVE
★ AUTOMATIC REFRIGERATION
★ CHEMICAL RECIRCULATION
★ COMPLETE PLUMBING
★

ALLEN

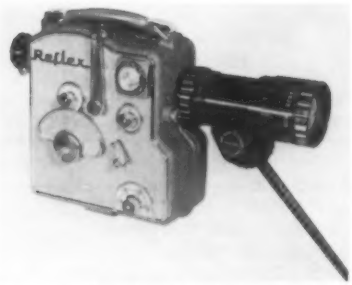
ALLEN REVERSAL PROCESSORS

Model 500

PRICES START AT $2995.

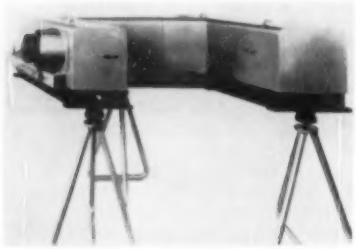
For complete information, write:

S. O. S CINEMA SUPPLY CORP.
Dept. T, 602 WEST 52nd ST., NEW YORK 19, N.Y.—PL 7-0440
Western Branch: 6331 Hollywood Blvd., Holly'd 28, Calif.—HO 7-2124



A new varifocal lens for the Camex-Reflex 8mm single-lens camera has been announced by Karl Heitz, Inc., 480 Lexington Ave., New York 17. Designated the Pan-Cinor 8–40mm, the *f*/1.9 lens is said to provide a continuous zoom range of up to 5× magnification. Available with 3-in. or 1-in. zoom lever, it focuses down to 3 ft. (with close-up lens to 1.5 ft). The lens is priced at $189. A lever and scale to set the diaphragm while filming are also available.

A new ColorTran Converter, the Cinemaster Chief Mark II, designed for economy and efficiency, especially when used in rugged location work with portable power generators, has been announced by Natural Lighting Corp., 630 South Flower St., Burbank, Calif. Six outlets are provided, each independently controlled by color-coded and numbered pushbutton switches. Exact color temperatures can be monitored and intensities may be selected and varied for each lamp or group on any outlet. The new unit also features a wider range input voltage control which allows compensation for line variations — 100/120 or 200/240 a-c. It is priced at $309.



The Schardin-Mach-Zehnder Interferometer has been introduced in the United States by Zoomar, Inc., 55 Sea Cliff Ave., Glen Cove, L.I., N.Y. Developed from the original Mach-Zehnder Interferometer, the new instrument is designed for flexibility to permit use in either a vertical or horizontal position. Applications include interferometric, schlieren and shadow methods of photography in various areas of research.

An electronic device to improve the acoustics of churches and auditoriums has been announced by Westrex Corp., a Division of Litton Industries, 6601 Romaine St., Hollywood 38. Called the Westrex 1400 Distributed Reverberation System, the device is for use in auditoriums where the natural reverberation time has been established primarily for voice sounds, and is thus too short for satisfactory reproduction of music. The system creates for each sound a complex train of repetitions in continuously diminishing volume from various parts of the auditorium. The sounds are repeated by recording them on magnetic tape and passing the tape over a succession of reproducing heads. Frequency of repetition is determined by tape speed and head spacing and can be adjusted to the requirements of the particular auditorium. The illusion of sound passing from front to back with successive reflections and diminishing volume is achieved by connecting each reproducing head to an individual pair of loudspeakers, distributed from front to back on opposite sides of the auditorium. Three groups of equipments are included in the basic system: tape transport, including erase, record and reproduce heads; distributed reverberation assembly, including recording and reproducing circuits; and an amplifier cabinet containing 60-w amplifiers for each speaker.

A tape head demagnetizer, featuring a special plastic sleeve on the tip of the probe to prevent accidental scratches, has been announced by Robins Industries Corp., Flushing 54, N.Y. Called the Model HD-3, it is designed mainly for amateur users of tape. It is priced at $5.95. The firm also offers the Model HD-6, a professional unit priced at $10.

A demagnetizer for bulk sound recording designed to serve the dual purpose of completely erasing the tape on the reel without rewinding, and demagnetizing record-playback and erase heads is manufactured by Amplifier Corp. of America, 398 Broadway, New York 13. The device, called the Magneraser, is available in two models, the 200C for 100 to 300 v, and the 220C for 200 to 260 v. Both models are priced at $24.

Tin-A-Lum, a low-temperature fluxless solder, has been introduced in the United States by Metals for Industry, Inc., 299 Pavonia Ave., Jersey City, N.J. The solder melts at extremely low temperatures, thus eliminating the danger of metal destruction under heat. It is used on aluminum and its alloys, zinc, tin, pewter, magnesium and other metals as well as castings. It can be polished and chromium plated and is said to be an excellent conductor of heat and electricity.

The PW-2, a 2-w power wire-wound resistor, has been announced by International Resistance Co., 401 Broad St., Philadelphia 8. The firm also manufactures 3-, 5-, 7-, 10-, 15- and 20-w sizes. Resistance elements of the new unit are wound on glass fiber cores. Tinned copper leads are secured to the element and the element-lead assembly is sealed in a rectangular ceramic case, providing a mechanical protective bond linking the resistance element, terminals and case. The resistance range is from 0.24 to 8200 ohms, and standard tolerances of ±5% and ±10% are available. The price of the PW-2 is $52 per thousand for the 10% tolerance unit.

PORTABLE HOT SPLICER
THE ONLY PROFESSIONAL PORTABLE HOT SPLICER WITH A BUILT-IN CARBIDE SCRAPER BLADE
BLADE GUARANTEED FOR LIFE!*
Model 135 (for 35 or 16 mm film) $329.50
Model 116 (for 16 or 8 mm film) $229.50
Scraper Pat. No. 2544082
See your photographic dealer or write to Traid Corporation for Specification Sheet No. 7.
TRAID CORPORATION
17136 Ventura Blvd., Encino, Calif., Telephone TRiangle 3-3373 or STate 8-2210
*Guarantee: Should blade ever need sharpening, Traid will sharpen for nominal handling charge of $1.00.
Traid Professional Portable Hot Splicer

employment service

These notices are published for the service of the membership and the field. They are inserted three months, at no charge to the member. The Society's address cannot be used for replies.

Positions Wanted

Film and AV Executive. Presently Audio Visual Manager for major corporation. Extensive overseas experience writing, directing and producing educational, documentary, public relation films. Experienced in almost all fields of film production and AV media preparation and production. Seeking position with challenge and future. Age 36, Married, M.A. in Cinema. Write: John H. Humphrey, 72-10 41st Ave., Jackson Hts. 77, N.Y.

Cameraman-Director. Available for forthcoming Confederate Centennial assignments throughout the entire central and deep south. Located near actual battlefields and areas where Centennial will be staged. Also available for assignments to Smoky Mts., Blue Ridge Mts., Cumberlands, Mississippi Delta and Okefenokee areas. Twenty years experience in high budget documentary film production. John O. Evans, 2313-B Starmount Cir., S.W., Huntsville, Ala.

Engineer-Administrator. Have designed, set up and managed motion-picture laboratories in color and black-and-white. Familiar with full range of operations and equipment in a laboratory. Graduate M.I.T.: M.S. in Chemical Engineering, B.S. in Business and Engineering Administration. Several languages. Desire challenging position. Apt. 2J, 130 Orient Way, Rutherford, N.J. WEbster 3-3238.

Representative. Graduate student working towards doctorate in Educational Television, receiving M.A. in motion pictures June 1961, B.A. in theater television, will be touring Latin America covering 64 cities in 20 countries and contacting over 100 television stations and 200 producers of newsreel, documentary, educational, television and feature films. Tour will be repeated each summer for three years. Also background three yrs electrical engineering and four yrs sales. Will represent your company and translate brochures into Spanish or Portuguese. Don Stewart, 2005 Sixth St., Santa Monica, Calif. EX 9-6795

Positions Available

Color Negative Printer Control Man. Photographic background, with color printing experience. Flexible hours. Paid benefits. New York City. CIrcle 6-5606. Mrs. Goldenberg.

Equipment Maintenance Men. Experienced in service and repair of one or more of the following types of equipment: Moviolas, sound projectors, Mitchell, Bell & Howell and Arriflex cameras, lens testing and calibration, audio and electronics for magnetic recorders and amplifiers, lighting and electrical equipment, machine shop. Write fully—experience and salary required. A. Florman, Florman & Babb, 68 West 45 St., New York 36.

Film Production Aide. The New York State Department of Civil Service will conduct an examination for Film Production Aide on April 29, 1961. Salary $3500 to $4350 in five annual increases. Open only to New York State residents. A Film Production Aide assists in preparations for shooting of motion picture film. Requires one year of paid experience in motion picture or television work and either one year of experience in operation of motion picture projector or one year of training in photography or television production or equivalent training and experience. For details contact the Recruitment Unit, Box 84-A, New York State Department of Civil Service, The State Campus, Albany 1, N.Y.

Soundman. Motion-picture recording studio requires alert soundman for staff. Must know all phases of sound recording including RCA equipment. Send resume to 446 East 86 St., Att: Monahan, Rm. 6-C, New York 27.

Film Processor. Motion-picture recording studio requires man for developing film in laboratory. Experience. Permanent. Write particulars to Mrs. M. Monahan, 446 East 86 St., Rm 6-C, New York 28.

Journals Wanted

These notices are published as a service to expedite disposal and acquisition of out-of-print Journals. Please write direct to the persons and addresses listed.

Complete set of Journals from January 1934 through June 1960. Excellent condition. For sale only as a set. Write: Don Norwood, 1470 San Pasqual St., Pasadena, Calif.

Complete file, Vol. I No. 1 through Dec. 1959 with indexes. Fine condition: $500. James G. Barrick, 15726 Fernway Ave., N. W., Cleveland 11, Ohio.

Complete set of Transactions, except Nos. 6 and 9, and all Journals published to date, including indexes. All in good condition. Price $500. Also extra copies of Transactions Nos. 21, 31, 32. W. W. Hennessey, RFD #2, Pound Ridge, N. Y.

Complete set of Journals from May 1937 to June 1954, including special volumes and membership directories, excellent condition; also Mar., May 1934 and July 1935 issues. Write: Harry R. Lubcke, 2443 Creston Way, Hollywood 28, Calif. HO 9-3266.

Jan-Dec. 1950; Jan., Feb., Apr.-Dec. 1951; Jan-Mar. 1952. Also available are vols. 6 and 7 of The Television Society (British) covering the period Jan. 1950 through Sept. 1955. Write: Andrew N. McClellan, 65 Hillside Drive, Toronto 6, Ont., Canada.

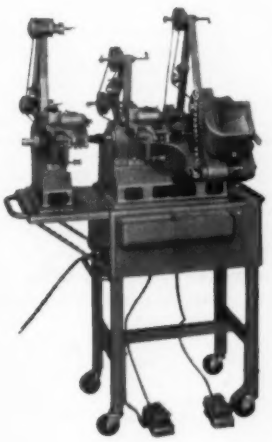
Dec. 1946, Feb.-Dec. 1947, 1948–1955 complete. All copies in perfect condition; for sale as entire lot only. Write: Joseph W. MacDonald, 2414 Sullivant Ave., Columbus 4, Ohio.

Jan. 1947 to Dec. 1957 complete and in perfect condition. For sale only as a set. Write: Charles J. Marshall, 2816 Royalston Ave., Kettering 19, Ohio.

Complete set of Journals Jan. 1949 to Dec. 1958. Perfect condition. What offers? Write: J. G. Jackson, 210 Kingsway South, Port Alberni, B. C., Canada.

Complete set of Journals, perfect condition, including special parts, directories, high-speed, etc. from Jan. 1949 to Dec. 1960 inclusive. write: Leslie Helhena, P.O. Box 643, Burbank, Calif.

ADD A SOUND HEAD to your MOVIOLA for multiple sound track editing



*Model UD-20-S shown with cabinet extension and extra sound head.

Cabinet extension bracket with mixing controls and coupling attachments complete.

$77.50

16mm or 35mm** Optical and magnetic sound head.

$495.00

1. Provisions for separate magnetic volume control over each sound head.
2. Plug-in attachments to amplifier.
3. Strong, easy to install from furnished instructions.

*Specify existing model Moviola for which extension is required.

**Specify 16 mm or 35 mm when ordering separate sound head.

Moviola MANUFACTURING CO.

1451 GORDON STREET • HOLLYWOOD • CALIFORNIA • HO. 7-3178

Résumés / Resumenes / Zusammenfassungen

Les caractéristiques des lampes à rayons cathodiques et des films photographiques dans l'enregistrement cinématographique pour la télévision

MEIER SADOWSKY [81]

Les nécessités actuelles dans l'enregistrement cinématographique pour la télévision se rattachent aux paramètres des lampes à rayons cathodiques relatifs aux phosphores, à l'écran, à l'aluminisation, à la grosseur du spot et aux caractéristiques de fonctionnement. L'auteur décrit les caractéristiques d'émission spectra'e et d'altération des phosphores relevant de la photographie; les effets des caractéristiques physiques du phosphore et de l'écran sont évalués par rapport aux problèmes concernant l'uniformité et les impuretés. L'auteur évalue aussi les méthodes de pose et les caractéristiques de réaction des films du commerce. Il explique la relation entre les caractéristiques de l'écran à phosphore et le film dans le système optique.

Analyseur de bande Video

A. A. GOLDBERG et M. R. HANNAH [85]

L'analyseur de bande Video (Video Tape Analyser: V.T.A.) s'emploie dans la production de bandes Video et mesure aisément les paramètres suivants de la bande: (1) Nombre et caractéristiques des omissions; (2) réponse comparative des fréquences; (3) valeur comparative des bruits de fond; (4) sensitivité comparative et niveau d'émission; (5) résistance mécanique de la bande à l abrasion. Du fait que le V.T.A., n'enregistre ni accumule l'information image, le maniement de la bande se trouve minimisé, le temps nécessaire à l'analyse est réduit et aucun circuit synchroniseur n'est nécessaire. L'opération du V.T.A. est décrite. (*Tr. Emil Thielens*)

Choix et spécification d'écrans à projection arrière

PETRO VLAHOS [89]

L'auteur examine en détail les caractéristiques de l'écran à projection arrière. Il est fourni des constantes numériques qui définissent ces caractéristiques pour les écrans de la pratique et convertissent les pieds-bougies en pieds-lamberts. L'article décrit une méthode par laquelle un écran optimum peut être spécifié pour une application donnée. On y discute les éléments humains et on y indique les valeurs numériques pour visionner la luminosité et les contrastes pour divers types de sujets projetés.

Nouvelles applications des techniques d'enregistrement en chantier

JACK J. CLINK [96]

L'enregistrement en chantier (défini comme étant un enregistrement obtenu avec un réseau enregistreur complètement autonome qu'on peut déplacer d'un chantier à l'autre) est un sujet d'un intérêt tout spécial pour le producteur de films indépendant. L'auteur décrit les méthodes d'enregistrement qui ont été conçues pour tirer le meilleur parti possible des réseaux d'enregistrement magnétique disponibles. L'article contient des recommandations sur le meilleur moyen d'obtenir des enregistrement d'une qualité uniformément supérieure en vue du réenregistrement ou transfert final.

L'élimination des bruits extérieurs pour les ateliers d'enregistrement

DONALD P. LOYE [98]

Tout récemment, on a foré des puits de pétrole à proximité d'ateliers d'enregistrement, ce qui a créé de nouveaux problèmes pour les bruits et les vibrations. Parmi les solutions de ces problèmes, il faut citer l'emplacement judicieux de chaque point de forage en fonction des activités des ateliers, l'isolement acoustique des chevalements de sondage et des machines annexes, et le montage des machines sur des bases qui isolent les vibrations. Ces problèmes sont examinés dans ce mémoire, ainsi que d'autres problèmes de bruits et de vibrations relatifs aux grandes routes express, aux avions et aux centrales électriques.

La commande des flashes au xénon de grande puissance par commutation magnétique

E. J. G. BEESON, A.E.I. Lamp and Lighting Co., Ltd., Leicester, Angleterre [101]

La décharge de l'arc au xénon est très sensible à un champ magnétique, de sorte que l'arc peut être dévié jusqu'à extinction. De cette manière, une lampe peut remplir une double fonction en émettant une radiation lumineuse tout en fonctionnant comme son propre coupe-circuit. Les études ont porté surtout sur un type de 2 kw de lampe au xénon à source compacte caractérisé par des pressions de gaz croissantes et des courants de lampe allant jusqu'à 1000 amp. En utilisant un champ magnétique pour éteindre l'arc et ainsi interrompre le courant de la lampe, on obtient essentiellement des pulsations de lumière à ondes de profil carré dans la zone de 10 à 100 msec. Avec ces courants de lampe élevés l'accumulateur à plomb et acide constitue une source d'énergie satisfaisante, et avec des éclairs lumineux d'un maximum de 50 kw on a également étudié les caractéristiques de l'arc et le débit du rendement lumineux. L'auteur fait aussi des comparaisons avec des types antérieurs de lampes à décharge qui sont d'un intérêt spécial pour la photographie à grande vitesse.

Le système de commutation magnétique de l'arc est déjà utilisé avec succès pour assurer un feu intermittent dans le phare de Dungeness. On obtient des puissances-éclair plus élevées et de durées plus courtes, ce qui permet de faire fonctionner les appareils de prise de vues à des vitesses plus grandes et d'aborder un domaine où les caméras à miroir tournant exigent des intensités de lumière encore plus élevées.

Techniques de caméra maculeuse

T. P. LIDDIARD, JR., et B. E. DRIMMER [106]

Des techniques diverses ont été perfectionnés qui augmentent notablement l'utilité de la caméra maculeuse à balayage pour la recherche de la détonation et des chocs. Quand l'auto-luminosité est insuffisante, on emploie plusieurs procédés pour renforcer la lumière, par ex. du ruban adhésif sur les surfaces explosives, des intervalles d'air ou d'argon, etc. Quand cela est necessaire, une lumière extérieure est fournie par des fils explosants, des lampes-éclair explosives, etc. Le changement abrupt dans l'intensité de la lumière réfléchie par la surface des matières opaques de haute reflectivité est utilisé pour enregistrer l'arrivée des chocs à la surface. Quand le pouvoir réfléchissant de la surface d'épreuve est faible, un revêtement mince de film plastique aluminisé signale clairement les temps d'arrivée des chocs. On observe de très faibles perturbations par les techniques schlieren, qu'on emploie la lumière transmise ou la lumière réfléchie. On peut utiliser des fentes multiples ou des systèmes à grille de configurations diverses pour augmenter la quantité des observations enregistrées. On peut aussi employer des "tubes lumineux" de filaments optiquement clairs pour transmettre des signaux lumineux de points qui sont inaccessibles à l'observation directe à des positions d'alignement à l'intérieur d'une même fente, ou encore à d'autres configurations appropriées. Les auteurs décrivent d'autres techniques, telles que la sciographie, la spectroscopie "fonction du temps" et l'emploi de film en couleur.

La caméra CORE: Réceptivité continue —Un seul élément tournant

J. N. WHYTE [111]

L'auteur examine les avantages d'une caméra à stries ayant une réceptivité continue et n'utilisant qu'un seul élément tournant. L'élément essentiel d'une telle caméra est une combinaison prisme-miroir qui est animée d'un mouvement de rotation rapide. Divers arrangements de cette combinaison sont possibles et ont été étudiés dans le but de compenser les effets d'aberration et de "dédoublement." L'auteur explique aussi la théorie de la formation de l'image par ladite combinaison et décrit en outre des variantes de ce système.

Características del oscilografo y de la pelicula fotografica con relación a la grabacion de peliculas para televísion

MEIER SADOWSKY [81]

Al presente los requerimientos para la grabación de películas para televisión están relacionados con los parámetros de las características de fluorescencia, de pantalla, de aluminización, de tamaño de exploración y de operación del oscilógrafo. Se describen las características de emisión espectral y de amortiguamiento de fluorescencia en lo tocante a fotografía; se valoran los efectos de las carácterísticas físicas del material fluorescente y de la pantalla, en relación con los problemas de uniformidad e impurezas. Se valoran los métodos de exposición y las caracterísficas de respuesta de la película que se consigue en el comercio. Se muestran las relaciones de las características de la pantalla fluorescente y la película en el sistema óptico.

Analizador de cinta de video

A. A. GOLDBERG y M. R. HANNAH [85]

El analizador de cinta de video (Video-Tape Analyzer: V. T. A.) Se emplea en la producción de cinta de video y mide satisfactoriamente los siguientes parámetros de cinta: (1) número y características de caídas; (2) respuesta comparativa de frecuencia; (3) valor comparativo de ruido; (4) nivel de salida y sensibilidad comparativa; (5) resistencia de la cinta al desgaste por rozamiento. Como el V.T.A. no graba ni retiene la información de la imagen, la prueba se realiza mediante una pasada de toda la cinta; por lo tanto, se reduce el manipuleo de la cinta, el tiempo necesario para hacer la prueba y no se necesita circuito de sincronización. Se describe el funcionamiento y manejo del V.T.A.

Selección y características de Pantallas de Proyección por transparencia

PETRO VLAHOS [89]

Se examinan detalladamente las características de la pantalla de proyección por transparencia. Se suministran constantes numéricas que definen estas características para pantallas practicas, y se dan las conversiones de bujias-pié a lamberts-pié. Se dá un procedimiento mediante el cual se pueden obtener las especificaciones de una pantalla óptima para una aplicación determinada. Se contemplan los factores humanos y se dan los valores numéricos para la luminosidad y el contraste, para varios tipos de material proyectado.

Nuevos aspectos de las Técnicas de grabación ambulante independiente

JACK J. CLINK [96]

La grabación ambulante independiente (definida como la grabación que se hace con un canal de grabación completamente independiente que puede llevarse de un sitio a otro) es objeto del mayor interés para el productor independiente. Se exponen métodos de grabación concebidos para utilizar en la mejor forma posible los canales de grabación magnética de que se dispone al presente. Se hacen sugerencias acerca de como producir mejor un material de calidad uniformemente alta para el transpaso final de la pista sonora de una película a otra.

Control de ruidos exteriores en estudios de grabación

DONALD P. LOYE [98]

Recientemente se han perforado pozos de petroleo en terrenos de propiedad de estudios de grabación, lo que ha creado nuevos problemas de ruido y vibración. La solución de estos problemas comprende la localización adecuada de cada sitio de perforación teniendo en cuenta las actividades de los estudios; aislamiento acústico de torres de perforación y otras instalaciones, y el montaje de la maquinaria sobre aisladores de vibración. Estos y otros problemas de ruido y vibración relacionados con carreteras, aeroplanos y plantas de energía eléctrica se describen en este artículo.

Regulación de destellos de xenon de gran potencia por interrupción mágnetica

E. J. G. BEESON [101]

La descarga del arco de xenon es muy suceptible a la influencia de un campo magético; el arco peude ser desviado hasta su extinción. De este doble: emitir radiación luminosa durante su funcionamiento, y a la vez servir como su propio interruptor automático. Las investigaciones han girado en torno del diseño de una lámpara de xenon de fuente-compacta de 2 kilovatios, con gas a presiones crecientes y corrientes hasta de 1.000 ampérios. Mediante el empleo de un campo magnético para extinguir el arco, y por consiguiente interrumpir la corriente de la lámpara, se obtie nen considerables impulsos luminosos de onda rectangular en la zona de los 10 a los 100 μseg. Con estas altas corrientes de la lámpara, para las cuales el acumlador de plomo consti tuye una fuente satisfactoria de energía eléctrica, y con destellos luminosos de hasta 50 kilovatios, se han estudiado las características de arco y la eficiencia luminosa de salida. Se hacen también comparaciones con los anteriores disenos de lámparas de descarga, las que son de especial interes en fotografía de alta velocidad.

La interrupción magnética del arco se está empleando ya con éxito para proveer de una luz de ocultaciones al faro Dungeness. Mayores potencias de destello se interrumpen con menores intervalos permitiendo la operación de cámaras de mayor velocidad, con lo que se entra en un campo en el que las cámaras de espejo rotativo requieren aún mayores intensidades luminosas.

Técnicas de cámara de borrosidad

T. P. LIDDIARD, JR. y B. E. DRIMMER [106]

En el Laboratorio de Armas Navales y otros se han desarrollado varias técnicas que aumentan enormemente la utilidad de la cámara de borrosidad de espejo rotativo. Caundo no hay suficiente autoluminosidad, se emplean varios métodos para mejorar la iluminación, por ejemplo, cinta Scotch sobre superficies explosivas, intervalos de aire o de argon, una capa de microbalones, etc. Cuando se necesita luz exterior, se obtiene con alambres explosivos, lámparas instantaneas explosivas, etc. La luz reflejada sobre superficies de materiales opacos se emplea para registrar la llegada de ondas de choque a una superficie. Cuando la reflectividad de la superficie a prueba es baja, una película muy delgada de Mylar aluminizado indica claramente el tiempo de llegada de las ondas de choque. Empleando el método estrioscópico con luz reflejada o transmitida se observan perturbaciones muy débiles. Sistemas de múltiples ranureas, o rejillas de varias configuraciones, pueden usarse para aumentar la cantidad de información registrada. Pueden usarse "tubos de luz" de filamentos de vidrio para transmitir señales luminosas desde puntos inaccesibles a la observación directa hasta posiciones que quedan en línea con una ranura, o hasta otras configuraciones convenientes. Se describen otras técnicas, tales como la de sincronización de velocidad, la de verificación óptica de perfiles por reflexión Scotch-Lite, la del empleo de película de colores y la de espectroscopia en función del tiempo.

a new SMPTE publication

CONTROL TECHNIQUES IN FILM PROCESSING

Prepared by a Special Subcommittee of the Laboratory Practice Committee of the Society of Motion Picture and Television Engineers

WALTER I. KISNER
Subcommittee Chairman

Foreword by **E. H. REICHARD**
Chairman, Laboratory Practice Committee

CHAPTERS

1. Introduction
2. General Principles
3. General Aspects of Motion-Picture Film Processing
4. Mechanical Evaluation and Control
5. Instruments for Photographic Control
6. Control Strips and Sensitometric Curves
7. Sensitometric Control of a Standardized Process
8. Chemistry of Film Processing
9. Chemical Analysis and Control
10. Economic Considerations in Establishing a Process Control System

Two-page bulletin with description of subject matter of each chapter available without charge upon request to Society Headquarters

$5.00

Available only for cash with order or by Company Purchase Order

Single copy price $5.00 (less 20% to SMPTE Members, Libraries and Booksellers), F.O.B. Destination

5 through 49 copies at $5.00 each, less 25%, plus foreign postage, F.O.B. Origin

50 copies or more at $5.00 each, less 33⅓%, plus foreign postage, F.O.B. Origin

Within New York City Add 3% Sales Tax

Society of Motion Picture and Television Engineers 55 West 42nd Street, New York 36, N.Y.

La cámara CORE: de receptividad continua y de un solo elemento rotativo

J. N. WHYTE [111]

Trata de las ventajas de una cámara de imagen unidimensional de receptividad continua con un solo elemento rotativo. El elemento esencial de esta cámara es una combinación de espejo-prisma que gira a gran velocidad. Los varios arreglos que pueden hacerse con esta combinación, han sido motivo de investigación, con el objeto de compensar los efectos aberracionales y "de corte". Se hace una reseña de la teoría de la formación de la imagen a través de la combinación y se ponen en consideración otros sistemas.

Charakteristiken der Kathodenstrahlröhren und photographischen Filme in Bezug auf Filmaufnahmen für Fernsehzwecke

MEIER SADOWSKY [81]

Moderne Filmaufnahmen für Fernsehzwecke sind abhängig von den Kathodenstrahlröhrenparametern von Phosphorbelägen, Schirm, Aluminisierung, Punktgrösse und Betriebseigenschaften. Es werden die Spektralausstrahlung und die Abklingcharakteristiken der Phosphorbeläge beschrieben soweit sie sich auf die Photographie beziehen. Der Einfluss der physikalischen Eigenschaften von Phosphor und Schirm wird hinsichtlich der Probleme der Gleichmässigkeit und Verunreinigungen abgeschätzt. Es folgt eine Abhandlung über Belichtungsmethoden und Ansprechcharakteristiken handelsüblicher Filme. Weiters wird die Beziehung zwischen Phosphorschirm und Film im optischen System dargelegt.

Video-Band Prüfapparat

A. A. GOLDBERG und M. R. HANNAH [85]

Der Video-Band Prüfapparat wird in der Produktion von Video-Bändern zur einfachen Messung folgender Parameter gebraucht: (1) Zahl und Eigenart der Oberflächenfehler, (2) Vergleich des Frequenzganges, (3) Vergleich des Rauschpegels, (4) Vergleich der Empfindlichkeit und der Aussteuerbarkeit, (5) Feststellung der mechanischen Abriebfestigkeit. Da der VTA Bildinformation weder aufzeichnet noch speichert, wird die Untersuchung während eines Banddurchlaufes vollendet; dadurch wird die Handhabung des Bandes vereinfacht und die Untersuchungszeit vermindert, wobei keine synchronisierte Schaltung erforderlich ist. Die Arbeitsweise des VTA ist beschrieben. (*Tr. J. Jeschke*)

Wahl und Spezifikation von rückwärts bestrahlter Projektionsflächen

PETRO VLAHOS [89]

Die Eigenschaften der von rückwärts bestrahlten Projektionsflächen werden in ihren Einzelheiten beschrieben. Der Verfasser gibt zahlenmässige Konstanten dieser Charakteristiken für praktische Flächen, wobei Fuss-Kerzen in Fuss-Lamberts umgewandelt werden. Es wird eine Arbeitsmethode beschrieben, nach welcher die Spezifikation einer für einen bestimmten Zweck bestgeeigneten Projektionsfläche gefunden werden kann. Es folgt eine Behandlung der persönlichkeitsbedingten Faktoren und es werden zahlenmässige Werte über betrachtungsmässige Helligkeit und Kontrast für verschiedene Arten von Projektionsmaterial gegeben.

Neue Wege zur Durchführung von Platzaufnahmen

JACK J. CLINK [96]

Platzaufnahmen werden definiert als Aufnahmen mit einem vollständig in sich abgeschlossenen Aufnahmekanal, der von einer Stelle zur anderen gebracht werden kann; sie sind für den auf eigene Rechnung arbeitenden Filmdirektor von besonderer Bedeutung. Es werden Aufnahmemethoden behandelt, die dazu bestimmt sind die bestmögliche Ausnützung gegenwärtig erhältlicher magnetischer Aufnahmekanäle zu erzielen. Der Artikel enthält Anregungen zur Erzielung von Aufnahmen gleichmässig hoher Qualität für die endgiltige Wiederaufnahme oder Übertragung.

Unterdrückung von Aussengeräuschen bei Sende- und Aufnahmeräumen

DONALD P. LOYE [98]

In jüngster Zeit haben sich neue Geräusch- und Vibrations-probleme dadurch ergeben, dass auf dem Aufnahmegelände Ölquellen gebohrt wurden. Zur Lösung dieser Probleme wurden folgende Verfahren angewandt: Zweckentsprechende Lage der Bohrstelle in bezug auf die Aufnahmearbeiten; akustische Isolierung der Bohrtürme und der ihnen angegliederten Maschinen; Aufsetzen der Maschinen auf vibrationsisolierende Sockel. Der Artikel beschreibt sowohl diese wie auch andere Geräusch- und Vibrationsprobleme die sich durch Strassen, Flugzeuge und elektrische Kraftwerke ergeben.

Die Regelung von Hochleistungs-Xenonblitzen durch magnetische Schaltung

E. J. G. BEESON, A.E.I. Lighting Co. Ltd, Leicester, England [101]

Die Xenon-Lichtbogenentladung wird durch ein magnetisches Feld stark beeinflusst und der Lichtbogen kann bis zum völligen Erlöschen abgelenkt werden. Auf diese Weise kann eine Lampe einen doppelten Zweck erfüllen, indem sie sowohl Licht ausstrahlt als auch gleichzeitig als ihr eigener Stromunterbrecher wirkt. Die Untersuchungen behandeln hauptsächlich ein 2 kW-Modell einer kompakten Xenonlampe mit ansteigenden Gasdrücken und Lampenströmen bis zu 1000 A. Dadurch dass ein Magnetfeld zum Löschen des Lichtbogens und damit zum Unterbrechen des Lampenstroms verwendet wird, ergeben sich fast Rechteckwellen-Lichtimpulse von 10 bis zu 100 Millisekunden. Die Blei und Säure-Batterie ist eine zufriedenstellende Kraftquelle für diese hohen Lampenströme und es wurden die Charakteristiken des Lichtbogens und der Nutzleistung an Licht an Lichtblitzen bis zu 50 kW untersucht. Es werden auch Vergleiche mit älteren Modellen von Entladungslampen angestellt, die für die Hochgeschwindigkeits-Photographie von besonderem Interesse sind.

Das Schalten mit magnetischem Lichtbogen wird bereits mit Erfolg dazu benützt ein aussetzendes Feuer im Leuchtturm von Dungeness zu betreiben. Grössere Blitzstärken werden mit kürzeren Dauerzeiten geschaltet, wodurch eine grössere Geschwindigkeit der Kamerabetätigung ermöglicht wird und man in das Gebiet kommt, wo Kameras mit rotierenden Spiegeln eine noch höhere Lichtintensität erfordern.

Methoden für die Schmier-Kamera

T. P. LIDDIARD, JR., und B. E. DRIMMER

Verschiedene Arbeitsmethoden sind ausgearbeitet worden, welche die Verwendbarkeit der Ablenkungs-"Schmier"-Kamera bedeutend erhöhen. Bei ungenügender Eigenluminosität werden verschiedene Mittel angewendet um das Licht zu verstärken, wie z.B. Zellophan-Klebestreifen auf Sprengstoff-Oberflächen, Luft- oder Argonspalten usw. Wenn notwendig wird äusseres Licht durch explodierende Drähte, Sprengstoff-Blitzlampen usw. verwendet. Die scharfe Veränderung in der Intensität des von der Oberfläche undurchsichtbarer Stoffe reflektierten Lichts wird benützt um das Eintreffen der Stosswellen an ihrer Oberfläche zu registrieren. Wenn die Reflexivität der zu untersuchenden Oberfläche gering ist so zeigt ein Uberzug mit dünn aluminiserten Plastik-Film die Ankunftszeit des Stosses deutlich an. Sehr geringe Störungen werden mit Schlierenmethoden beobachtet, wobei entweder Durchleuchtung oder reflektiertes Licht angewendet wird. Mehrfache Schlitz- oder Gittersysteme verschiedener Formen können angewendet werden, um die Menge der aufgenommenen Daten zu vergrössern. "Lichtleitungen" aus optisch klaren Fäden können dazu benützt werden um Lichteindrücke zu übermitteln und zwar von Punkten, die direkter Beobachtung unzugänglich sind zu Stellen die in einer Linie mit einem bestimmten Schlitz oder geeigneten Stellen liegen. Es werden auch noch andere Methoden beschrieben, wie z.B. Geschwindigkeits-Synchronisation, Schattenaufnahmen, zeitabhängige Spektroskopie, und der Gebrauch von Farbfilm.

Die CORE Kamera: kontinuierliche Aufnahmefähigkeit—ein rotierendes Element

J. N. WHYTE [111]

Es werden die Vorteile einer Schlierenkamera mit kontinuierlicher Aufnahmefähigkeit und nur einem rotierenden Element erörtert. Der Hauptbestandteil einer solchen Kamer ist eine Kombination von Prisma und Spiegel, die mit grosser Geschwindigkeit rotiert. Es sind verschiedene Anordnungen dieser Kombination möglich und sie wurden im Hinblick auf die Möglichkeit der Kompensation für Aberrations- und "Spalt"-effekte untersucht. Es wird die Theorie der Bildformung durch die Kombination behandelt und es werden alternative Pläne erörtert.

Ed. Note: Beginning last month we are publishing in the *Journal* as a regular feature translations of the titles and abstracts of all papers in French, German and Spanish. This is intended to increase the *Journal's* usefulness to the Society's growing number of non-English speaking members and subscribers overseas. Comments of readers are invited. The Society is particularly anxious that the translations used should be of the best quality obtainable, therefore comments on their quality and suggestions for their improvement would be especially welcome. Also, since the cost of buying all the translations from a commercial translator is prohibitive, any assistance that may be volunteered in obtaining translations for the *Journal* will constitute a very considerable contribution to the Society. Contributors will of course, be given full acknowledgment in the *Journal*.

Contents — pages 114–144

News Columns

89th Convention and Equipment Exhibit 114
Education, Industry News 116
Biographical Note: Fred E. Altman 118
Abstracts 118
New Members 132
SMPTE Test Films 134
New Products 136
Employment Service 141
Journals Available 141
Résumés—Resumenes—Zusammenfassungen . . 142

Advertisers

Arriflex Corp. of America 137
Bach Auricon, Inc. 117, 127
Burke & James, Inc. 138
Camera Equipment Co. 128
Camera Mart, Inc. 124
Classified 139
Conrac, Inc. 122
Filmline Corp. 130
Florman & Babb, Inc. 135
Fulton Productions, Inc. 123
Gevaert Photo Producten N.V. 133
Hi-Speed Equipment, Inc. 120
Hollywood Film Co. 131
Philip A. Hunt Co. 121
Intercinema Corp. 132
Magnasync Corp. 129
Magna-Tech Electronic Co., Inc. 119
Movielab Film Laboratories, Inc. 125
Moviola Manufacturing Co. 141
Pan American Films 130
Peerless Film Processing Corp. 126
Photo Research Corp. 134
Professional Services 136
Reeves Soundcraft Corp. 117
SMPTE. 143
S.O.S Cinema Supply Corp. 139
Traid Corp. 140
Western Cine Service 118

Meeting Calendar

ASME, National Aviation Division Conference, Mar. 12–16, Statler Hotel, Los Angeles.
American Society of Photogrammetry, ASP-American Congress on Surveying and Mapping, Mar. 19–25, Shoreham Hotel, Washington, D.C.
IRE International Convention, Mar. 20–23, New York Coliseum, New York.
National Microfilm Association, National Convention, Apr. 4–6, Hotel Sherman, Chicago.
ASTM, Committee F-1 on Materials for Electron Tubes and Semiconductor Devices, Apr. 5–7, Benjamin Franklin Hotel, Philadelphia.
Inter-Society Color Council, 30th Annual Meeting, Apr. 10–12, Sheraton Hotel, Rochester, N.Y.
ISA, 7th National Symposium on Instrument Methods of Analysis, Apr. 17–19, Shamrock-Hilton Hotel, Houston, Texas.
DAVI, Apr. 24–28, Deauville Hotel, Miami Beach, Fla.
Electrochemical Society, Symposium, Apr. 30–May 4, Claypool Hotel, Indianapolis, Ind.
ISA, 7th National Aero-Space Instrumentation Symposium, May 1–4, Fort Worth, Tex.
AICE, National Meeting, May 7–10, Sheraton-Cleveland Hotel, Cleveland, Ohio.
89th Semiannual Convention of the SMPTE, May 7–12, King Edward Sheraton, Toronto.
SPSE, Annual Conference, May 8–12, Arlington Hotel, Binghamton, N.Y.
AIEE, IRE, Association for Computing Machinery, Western Joint Computer Conference, May 9–11, Ambassador Hotel, Los Angeles.
IRE Professional Group on Microwave Theory and Techniques, National Symposium May 15–17, Sheraton-Park Hotel, Washington, D.C.
AIEE, ARS, IAS, IRE, ISA, National Telemetering Conference, May 22–24, Sheraton Towers Hotel, Chicago.
ASME, Semiannual Meeting, June 11, Los Angeles.
AIEE, Summer General Meeting, June 18–23, Ithaca, N.Y.
AIChE, AIEE, ASME, IRE, ISA, Joint Automatic Control Conference, June 28–30, Univ. of Colorado, Boulder, Colo.
IFME, JECMB, IRE-PGBME, 4th International Conference on Medical Electronics and 14th Conference on Electronic Techniques in Medicine and Biology, July 9–14, Waldorf-Astoria Hotel, New York.
NAVA, Annual Convention, July 22–25, Hotel Morrison, Chicago.
American Rocket Society, Guidance and Control Conference, Aug. 7–9, Stanford Univ., Stanford, Calif.
SPIE, National Convention, Aug. 7–10, Ambassador Hotel, Los Angeles.
Western Electronic Show and Convention, Aug. 22–25, San Francisco.
American Chemical Society, 6th International Conference on Coordination Chemistry, Aug. 27–Sept. 1, Wayne State Univ., Detroit, Mich.
UFPA, Annual Meeting, August 1961, Berkeley Campus, U. of California.
PGIT, International Symposium on Transmission and Processing of Information, Sept. 6–8, MIT, Cambridge, Mass.
AIEE, ISA, IRE, Joint Nuclear Instrumentation Symposium, Sept. 6–8, North Carolina State College, Raleigh, N.C.
Standards Engineers Society, Annual Meeting, Sept. 18–20, Hotel Sherman, Chicago.
IRE, AIEE, Industrial Electronics Symposium, Sept. 20–21, Boston, Mass.
Illuminating Engineering Society, National Technical Conference, Sept. 24–29, Chase-Park Plaza Hotel, St. Louis, Mo.
Electrochemical Society, Fall Meeting, Oct. 1–5, Statler Hotel, Detroit, Mich.
IRE, Canadian Electronic Conference, Oct. 2–4, Automotive Bldg., Exhibition Park, Toronto, Ont.
90th Semiannual Convention of the SMPTE, Oct. 2–6, Lake Placid, N.Y.
National Electronics Conference, Oct. 9–11, International Amphitheatre, Chicago.
American Standards Association, National Conference, Oct. 10–12, Rice Hotel, Houston, Texas.
Society of Reproduction Engineers, Visual Communications Congress, Dec. 1–4, Hotel Biltmore, Los Angeles.
91st Semiannual Convention of the SMPTE, Apr. 30–May 4, 1962, Ambassador Hotel, Los Angeles.
92nd Semiannual Convention of the SMPTE, Oct. 22–26, 1962, Drake Hotel, Chicago.
93rd Semiannual Convention of the SMPTE, Apr. 22–26, 1963, Traymore Hotel, Atlantic City, N.J.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections, Subsections and Chapters and of the Committee Chairmen and Members were published in the April 1960 Journal Part II.

sustaining members

of the Society of Motion Picture and Television Engineers

The objectives of the Society are:

- Advance in the theory and practice of engineering in motion pictures, television and the allied arts and sciences;
- Standardization of equipment and practices employed therein;
- Maintenance of high professional standing among its members;
- Guidance of students and the attainment of high standards of education;
- Dissemination of scientific knowledge by publication.

Progress toward the attainment of these objectives is greatly aided by the financial support provided by the member companies listed below.

Acme Film Laboratories, Inc.
Alexander Film Co.
Altec Service Company
  Altec Lansing Corporation
American Broadcasting-Paramount Theatres, Inc.
  ABC-TV Network
  ABC Films, Inc.
Ampex Professional Products Company
Animation Equipment Corp.
Ansco
Arriflex Corp. of America
C. S. Ashcraft Mfg. Company, Inc.
The Association of Cinema Laboratories, Inc.
Association of Professional Cinema Equipment Dealers of New York
  Camera Equipment Company, Inc.
  The Camera Mart, Inc.
  Florman & Babb, Inc.
  National Cine Equipment, Inc.
  S.O.S Cinema Supply Corporation
Atlas Film Corporation
Audio Productions, Inc.
Bach Auricon, Inc.
Bausch & Lomb Incorporated
Beckman & Whitley, Inc.
Bell & Howell Company
Bonded Film Storage
  (Division of Novo Industrial Corp.)
Brooks Cameras & Supply
Byron Motion Pictures, Inc.
S. W. Caldwell Ltd.
Calvin Productions, Inc.
Capital Film Laboratories, Inc.
Oscar F. Carlson Company
Century Lighting, Inc.
Century Projector Corporation
Cineffects, Inc.
Cinesound, Ltd., Canada
Geo. W. Colburn Laboratory, Inc.
Color Reproduction Company
Color Service Company, Inc.
Columbia Broadcasting System, Inc.
  CBS Television Network;
  CBS Television Stations; CBS News;
  CBS Films; Terrytoons
Commonwealth-Filmcraft Laboratories Pty. Ltd.
Comprehensive Service Corporation
Consolidated Film Industries
Dage Television Division of Thompson Ramo Wooldridge Inc.
DeFrenes Company
DeLuxe Laboratories, Inc.
Desilu Productions, Inc.
Du Art Film Laboratories, Inc.
  Tri Art Color Corporation
E. I. du Pont de Nemours & Co., Inc.
Eastern Effects, Inc.
Eastman Kodak Company
Edgerton, Germeshausen & Grier, Inc.
Elgeet Optical Company, Inc.
Max Factor & Co.
Field Emission Corporation
Filmline Corporation
Dr.-Ing. Frank Früngel GmbH
GPL Division of General Precision, Inc.
General Electric Company
General Film Laboratories Corporation
W. J. German, Inc.
The Gevaert Company of America, Inc.
Guffanti Film Laboratories, Inc.
Frank Herrnfeld Engineering Corp.
Hi-Speed Equipment Incorporated
Hollywood Film Company
Hollywood Film Enterprises, Inc.
Houston Fearless Company
Philip A. Hunt Company
Hunt's Theatres
Hurletron Incorporated
Hurley Screen Company
JM Developments, Inc.
The Jam Handy Organization, Inc.
Jamieson Film Co.
The Kalart Company Inc.
  Victor Animatograph Corporation
Kear & Kennedy Engineering
Keitz & Herndon, Incorporated
KIN-O-LUX, Inc.
Kollmorgen Optical Corporation
Labcraft International Corporation
LAB-TV
Robert Lawrence Productions, Inc.
Lipsner-Smith Corporation
Lorraine Arc Carbons,
  Division of Carbons, Inc.
M.G.M. Laboratories, Inc.
Mecca Film Laboratories Corporation
D. B. Milliken Company
Minnesota Mining & Manufacturing Co.
Mitchell Camera Corporation
Mole-Richardson Co.
Monaco Laboratories
Motion Picture Association of America, Inc.
  Allied Artists Pictures Corporation
  Buena Vista Film Distribution Company, Inc.
  Columbia Pictures Corporation
  Loew's Incorporated
  Paramount Pictures Corporation
  Twentieth Century-Fox Film Corp.
  United Artists Corporation
  Universal Pictures Company, Inc.
  Warner Bros. Pictures, Inc.
Motion Picture Enterprises, Inc.
Motion Picture Laboratories, Inc.
Motion Picture Printing Equipment Co.
Movielab Film Laboratories, Inc.
Moviola Manufacturing Co.
National Carbon Company, Division of Union Carbide Corporation
National Screen Service Corporation
National Theatre Supply Company
Neumade Products Corporation
W. A. Palmer Films, Inc.
Pan-American Films
Panavision Incorporated
Pathé Laboratories, Inc.
Photo-Animation, Inc.
Photo-Sonics, Inc.
Pittsburgh Motion Picture Lab
Precision Laboratories
  (Division of Precision Cine Equipment Corporation)
Prestoseal Mfg. Corp.
Producers Service Company,
  Division of Boothe Leasing Corp.
Radio Corporation of America
  National Broadcasting Company
  Broadcast and Television Equipment Division
Rank Precision Industries Ltd.
  G. B-Kalee Division
Rapid Film Technique, Inc.
Reid H. Ray Film Industries, Inc.
Reeves Sound Studios, Inc.
RIVA-Munich
Charles Ross Inc.
Russell-Barton Film Company
L. B. Russell Chemicals, Inc.
Ryder Sound Services, Inc.
Bruce J. Scrievers, Consulting Engineer
Scripts By Oeveste Granducci, Inc.
Smith, Kline & French Laboratories
Snazelle Productions, Inc.
Southwest Film Laboratory, Inc.
The Strong Electric Company
Sylvania Electric Products, Inc.
Technicolor Corporation
TELIC, Incorporated
Titra Film Laboratories, Inc.
Traid Corporation
Trans-Canada Films Ltd.
Van Praag Productions
Alexander F. Victor Enterprises, Inc.
Westinghouse Electric Corporation
Westrex Corporation
Wilding Inc.
Wollensak Optical Company

The Society invites applications for Sustaining Membership from other interested companies. Information may be obtained from the Chairman of the Sustaining Membership Committee, Ethan M. Stifle, Eastman Kodak Co., Room 626, 342 Madison Ave., New York 17, N.Y.